MECHANICAL ENGINEERING

October 1956

in this issue

European Design Trends—
in Mechanical Materials Handling . . *H. W. von der Recke* 906

Psychological Tests in an
Engineering Department . . . . . *J. M. Parish* 912

The Solar Furnace—New Tool for
High-Temperature Work . . *Guy Benveniste and N. K. Hiester* 915

Burning Fluid Coke . . . . . *Ollison Craig and E. H. Smith* 921

Human Engineering—
A New Approach to Operational Design . *G. A. Peters, Jr.* 926

Test Facilities—
Aeronautical Turbine Laboratory . . . . . *L. G. Tilton* 927

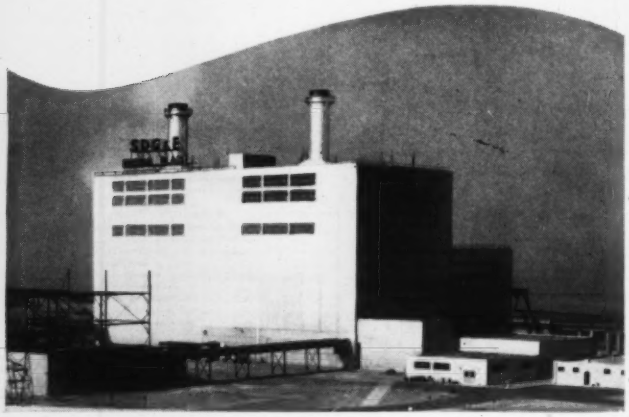
Industry Under Enemy Attack . . . . . *B. W. Bruckmann* 932

DEPARTMENTS

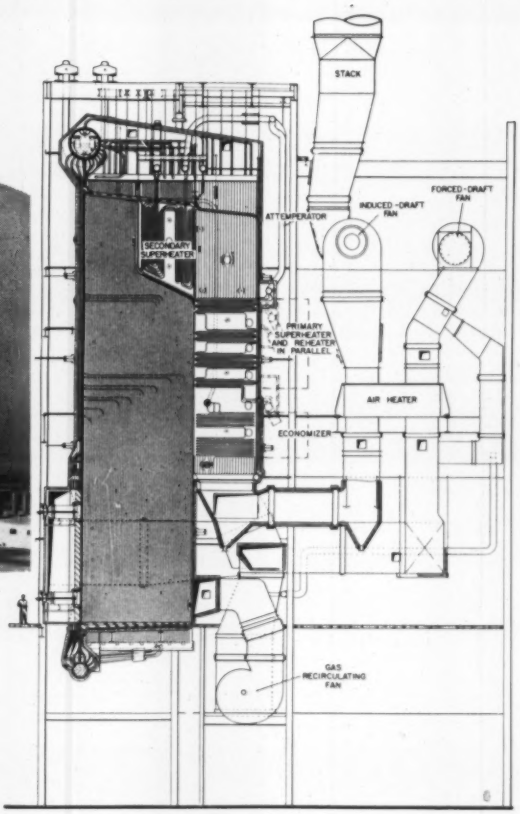
Editorial 905
Briefing the Record. . . 937
European Survey . . . 950
ASME Technical Digest . 952
Comments on Papers . . 966
ASME Boiler and
Pressure Vessel Code . 969
ASME News. 971
Roundup. 990
Keep Informed . . Adv. p. 41

ASME Annual Meeting • New York, N. Y. • November 25-30, 1956

B&W Radiant Boilers at Encina are fired with oil or natural gas, with provision for future use of coal. Each unit produces 775,000 lb of steam per hr. Pressure is 1550 psi and temp. 1000 F, with reheat to 1000 F. Design features gas recirculation and cyclone steam separators for natural circulation. Boiler design pressure is 1725 psi.



Modern Encina Power Plant is the latest addition to San Diego Gas & Electric Company's expanding facilities. With two units already in operation, excavation is already underway for a third unit which is scheduled to be in operation in 1958. The design engineering firm is Pioneer Service and Engineering Company, Chicago, Illinois.



San Diego Gas and Electric Company's

ENCINA POWER PLANT

installs New B&W Radiant Reheat Boilers to assure low maintenance—efficient steam generation

Since 1941, this progressive utility has increased its generating capacity almost five times. Its capital investment has grown to about 200 million dollars, and still further expansion is scheduled beyond 1958.

Concrete evidence of this foresighted policy is the new Encina Power Plant. Unit No. 1 went on the line in 1954. Unit No. 2 was placed in operation in July of this year.

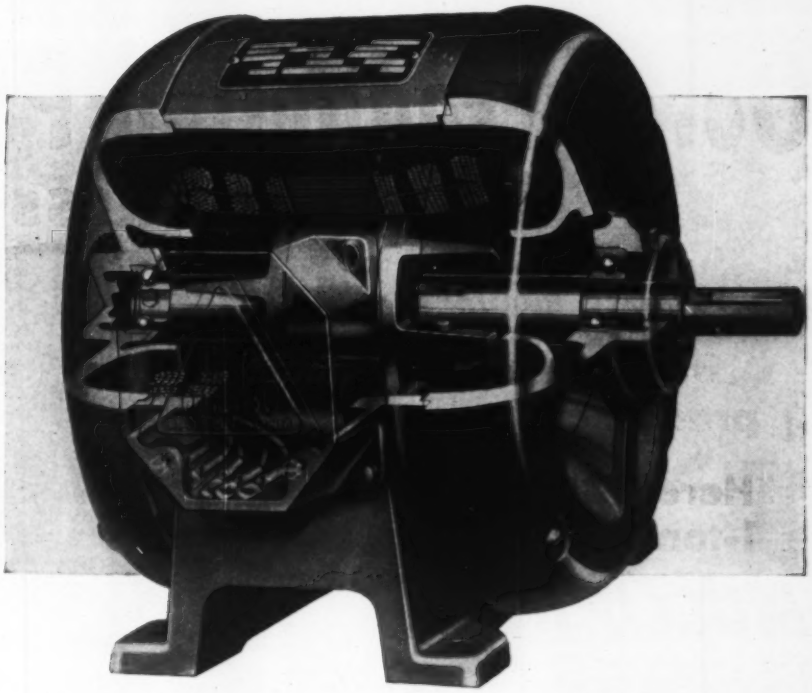
Steam at Encina is generated by B&W Radiant Reheat Boilers. These boilers with their turbines and generators increase generating capacity by 212,000 kw—three-eighths of the system total. These are the 34th and 35th B&W boilers to be installed by this utility since 1903. Their choice for Encina is a reflection of long service satisfaction.

B&W boilers are products of 90 years of boiler engineering and construction experience, plus advances gained through B&W's continuing, intensive research and development activities. This strong combination has but one purpose—to build better boilers to help raise steam-electric power generation to new levels of efficiency. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

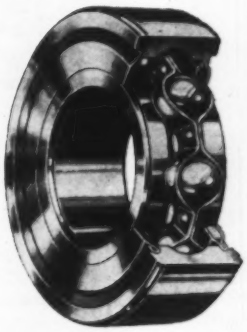
G-816-CS

BABCOCK & WILCOX

BOILER DIVISION



BALL BEARINGS CUT LUBRICATION MAINTENANCE TO VIRTUALLY ZERO



Precision-made New Departure ball bearings assure permanently accurate support of the rotor shaft under all load conditions and mounting positions, plus cool-running, quiet bearings at all speeds.

In normal operation, New Departure sealed and shielded bearings reduce lubricating requirements to virtually zero. Built-in seals on the inside faces prevent grease leakage *into* the motor. Metal shields at the outer faces keep foreign matter *out* of the bearings while permitting entry of just the right amount of grease from the end bell for perfect bearing operation. Overheating from excessive lubrication can't occur.

Join the leaders who look to New Departure for bearings and engineering service in product development and improvement. New Departure, Division of General Motors, Bristol, Connecticut.

BALL BEARINGS MAKE GOOD PRODUCTS BETTER

SEE "WIDE WIDE WORLD"
SUNDAYS—NBC-TV

NEW DEPARTURE
BALL BEARINGS

GM GENERAL MOTORS

NOTHING ROLLS LIKE A BALL

MECHANICAL ENGINEERING, October, 1956, Vol. 78, No. 10. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members $3.50 annually, single copy 50¢; to nonmembers $7.00 annually, single copy 75¢. Add $1.50 postage to all countries outside the United States, Canada, and the Pan-American Union. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

Got a Production Problem?

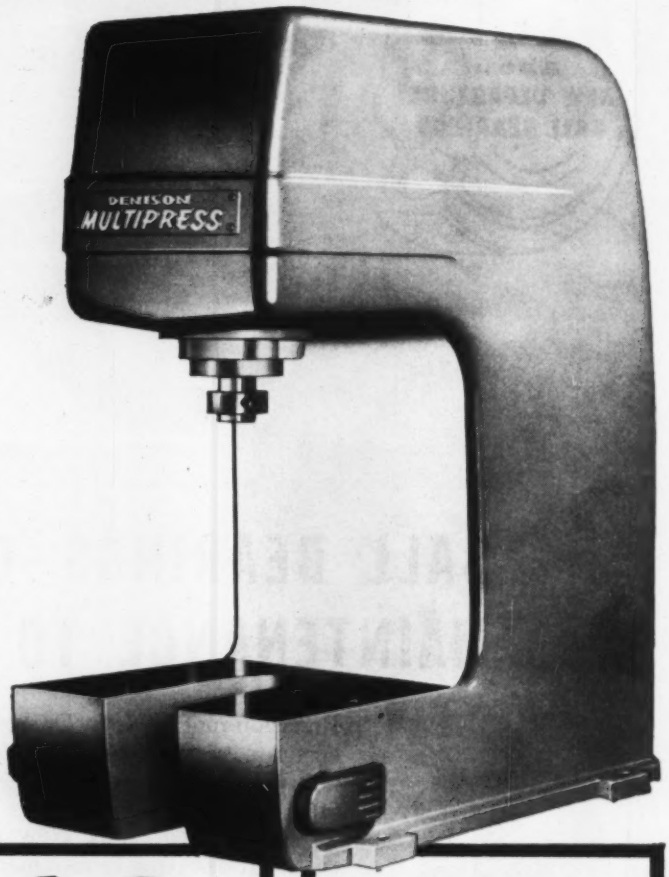
...THAT NEEDS A PRESS NOW

Immediately Available

High-speed production tool

Here's a NEW 1-ton hydraulic

MULTIPRESS®



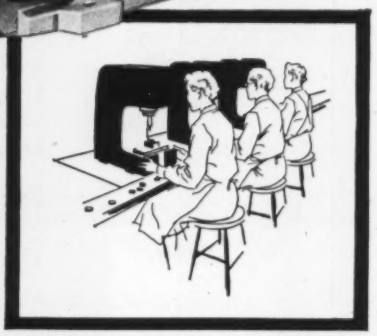
- Gives up to 750 ram strokes per minute.
- Ram pressures adjustable up to 1-ton.
- Automatic pressure reversal.
- Completely self contained.
- Your present tooling easily adaptable.
- Dual manual safety control.

Only $395.00

F.O.B. Factory. Subject to prior sale

CUTS YOUR TOOLING COSTS ON SMALL AND LARGE QUANTITY LOTS—Many shop operations can be simplified because you can move Multipress quickly and easily from department to department, wherever a press is needed. And, because Multipress can be moved around, it can be stored in your tool crib complete with tooling setup until the particular production job is run again.

SIMPLIFIES AUTOMATIC OPERATIONS—Multipress is specially engineered for automation. It can be mounted simply around dial tables and indexing fixtures to keep your tooling costs to an absolute minimum. The Multipress controls can be actuated electrically, pneumatically or hydraulically from external sources making it easy to interlock the Multipress in with other automatic production operations.



IDEAL FOR CONTINUOUS LINE PRODUCTION—Two or more Multipress units can be easily set up side by side to handle straight line production work. Surprisingly small bench area is needed for line production work because of the compact, operator-engineered design developed in the 1-ton Multipress.

WRITE NOW

DENISON ENGINEERING DIVISION
American Brake Shoe Co.
1174 Dublin Road Columbus 16, Ohio

DENISON HydrOILics

The Frank G. Hough Co., Libertyville, Ill., manufactures "Payloader" tractor-shovels and towing tractors in three types: front-wheel-drive, rear-wheel-drive and four-wheel-drive.

ARISTOLOY STEELS

"Payloader" Parts Produce Production Profit

...When Made From a COPPERWELD LEADED ALLOY

This complex gear assembly is made in six separate operations, or set-ups, with a tooling sequence of 13 machining operations. When the manufacturer switched from unleaded to Copperweld leaded 8620, the faster feeds and speeds gave them a production increase of better than 25%. For example, the surface feet per minute in a finish bore operation increased from 200 SFM to 300 SFM. In addition, tool life increased 60%. Copperweld Leaded Steel, the steel with "built-in productivity" produced profit in this "Payloader" part.

For further details, write for free booklet, "Lead Treated Steels"

COPPERWELD STEEL COMPANY • STEEL DIVISION • WARREN, OHIO
EXPORT: Copperweld Steel International Co., 225 Broadway, New York 7, N. Y.

STEPHENS

the big name

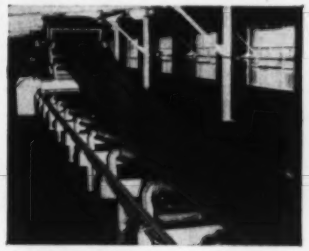
-ADAMSON

coal conveying systems for power

To squeeze every last kilowatt from every ton of coal consumed, power producers know the conveying system must be right. It means a system properly engineered to the specific need with low initial installation cost. It means one that requires minimum maintenance and operational manpower for years to come.

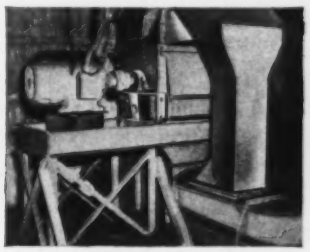
S-A engineer strategists have been planning and building such conveying systems for over fifty years. At this very moment, many of them are helping to provide cheap power in hundreds of private and utility power plants all over the world.

Stephens-Adamson sales engineers, backed by the most complete line of manufactured equipment, blanket all important industrial areas. They can show you why it pays to convey with S-A.



An S-A belt conveyor brings coal into a mid-west power plant. A belt tripper deposits the fuel into bunkers through traveling tripper spouts.

S-A Redler conveyors provide dust-tight coal movement from storage bunkers. Redler designs permit easy coal movement over horizontal, vertical, or inclined planes.



An institutional power plant employs S-A Knittel crusher to reduce coal lump size. It will handle damp coal without plugging or decrease in capacity.

S-A manufactures a wide range of material handling products in three complete plants in U. S. and Canada.

Belt Conveyors
Belt, Pan & Plate Feeders
Ship Loading Boom Conveyors
Stacking Conveyors
Storage & Reclaiming Systems
"Natural Frequency" Vibrating Conveyors
REDLER Conveyor-Elevators
ZIPPER Conveyor-Elevators
Conveyor Belt Cleaners
Headshaft Holdbacks
Grizzlies & Screens
Centrifugal Pilers
Bin Gates & Tunnel Gates
Car Pullers & Spotters
Bucket Elevators
Skip Hoists
SEALMASTER Ball Bearing Units

• *Write for a bulletin on any of the above products.*

STEPHENS-ADAMSON MFG. CO.
19 RIDGEWAY AVENUE, AURORA, ILLINOIS
LOS ANGELES, CALIFORNIA
BELLEVILLE, ONTARIO

U.S.P. PATENTED STAINLESS STEEL PROCESS

Centrifugally cast stainless steel pipe passes rigid specifications . . . including severe hydrostatic pressure test.

The men who design today's petrochemical plants, refineries or Atomic power plants are confronted with piping problems involving temperatures, pressures and corrosive conditions which only a few years ago would have been called impractical, if not impossible.

U. S. Pipe's Steel & Tubes Division recently completed a piping requirement for 700 feet of Type 316 Extra Low Carbon, columbium-bearing stainless for a large petrochemical plant, which is typical of the job metal mold centrifugally cast pipe is doing today under a patented manufacturing process with rigid Quality Control.

U. S. Pipe is headquarters for metal mold centrifugally cast alloy and stainless steel pressure pipe over a wide range of special and standard analyses — in large or small quantities.

Write and outline your stainless piping problems. We may be able to help.

Note these exacting specifications on 316 Cb ELC Stainless Steel Pipe demanded by one of nation's leading oil companies:

Material Requirements: Pipe shall conform to ASTM Specification A-362-52T.

Chemical Analysis: Modified AISI Type 316 Cb (ELC), with *one percent* spread on chrome and nickel.

Finish: Each pipe to be turned, bored and faced to surface finish of 125 micro inch or better. O.D. tolerance plus 1/16" minus 0"; I.D. tolerance plus 0" minus 1/32". Pipe size: 12" O.D. x 1.17" wall.

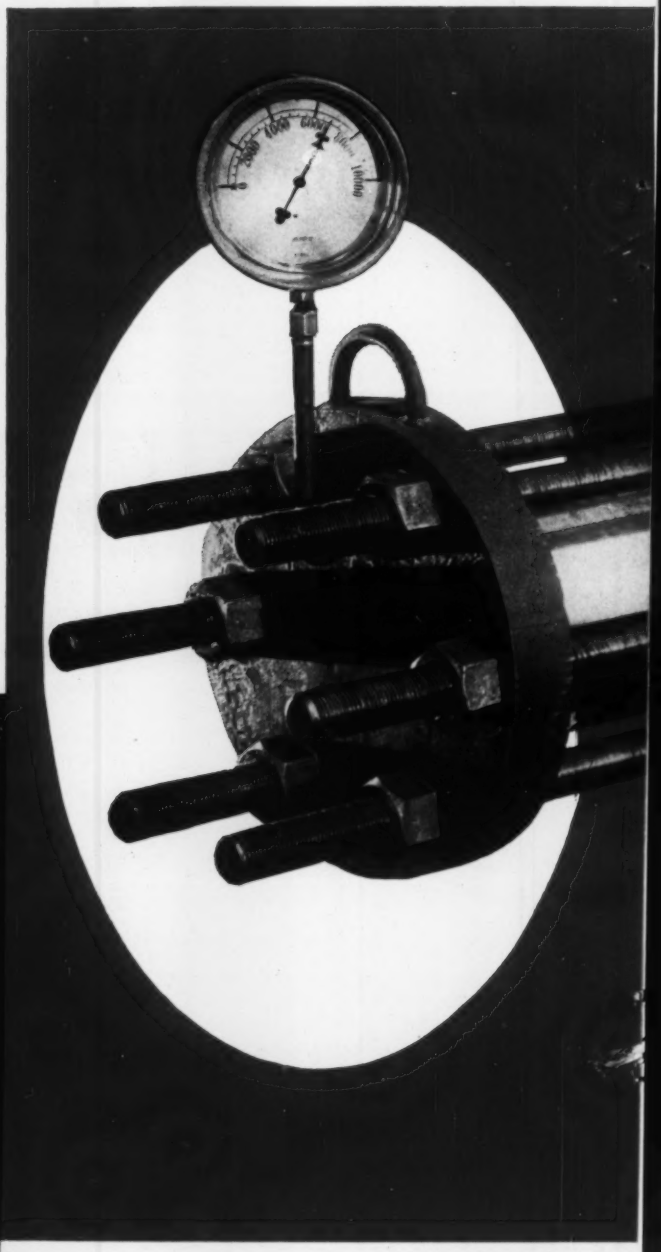
Mechanical Tests: Tensile Tests—2 tests required on each pipe after heat treatment; one at room temperature, one at 700° F.

Inspection Requirements

1. Etching test on sections cut from each end of pipe.
2. Radiographic Inspection — Required complete circumferential coverage of at least an 8" wide section at each end of each pipe in accordance with ASTM Specification E71-52.
3. Fluid Penetrant — Entire O.D. and I.D. surface each piece.

Heat Treatment: Heat for 4 hours at 2100° F.—2150° F., water quench, follow by 5 hours at 1500° F.—1600° F. Cool in still air.

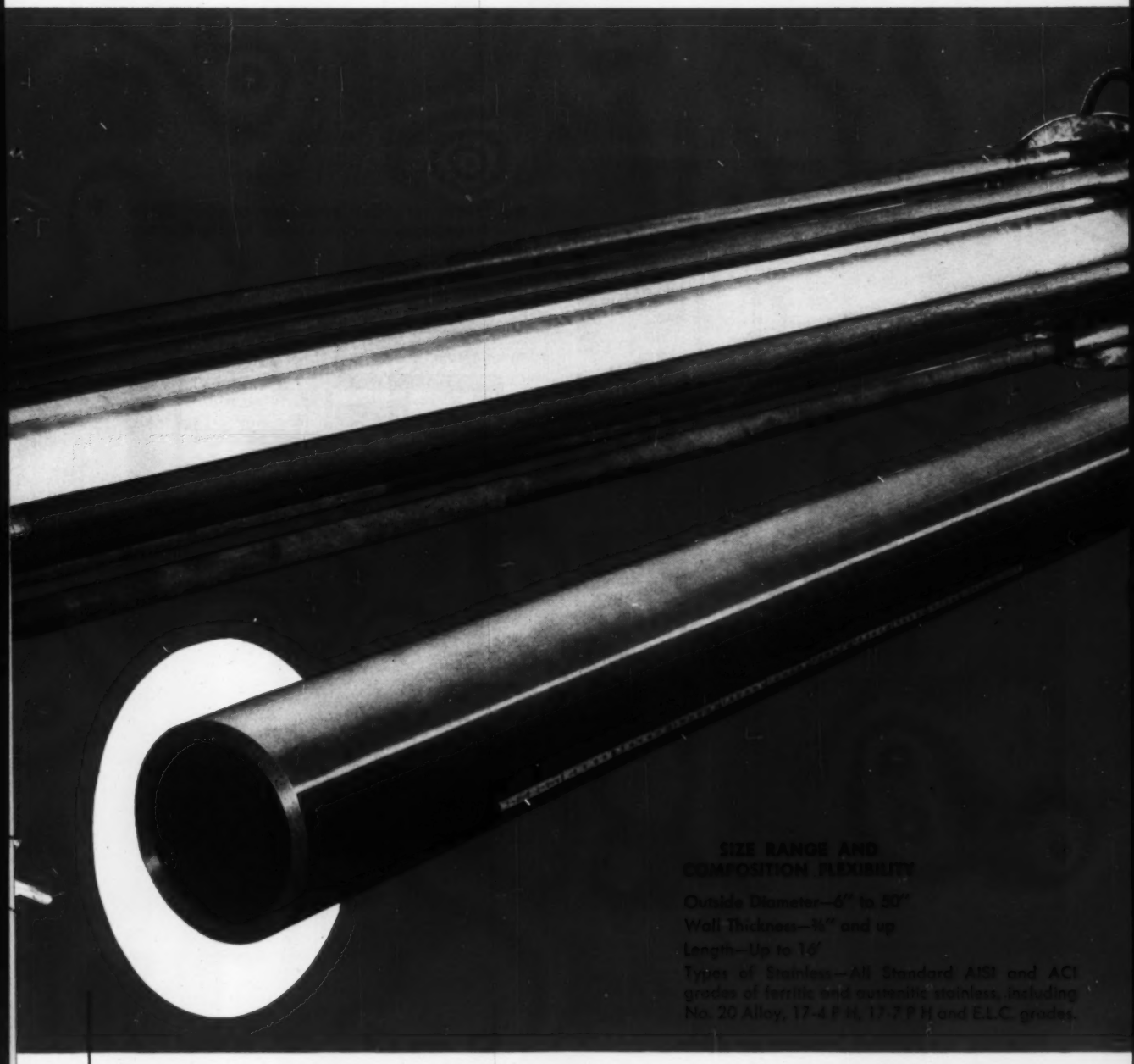
Hydrostatic Test: Each length tested to stress of either 90% of the minimum cold yield strength or a maximum pressure of 6800 psi — whichever is lower.



UPPER: Hydrostatic test rig used to qualify each length of pipe.

LOWER: Turned and bored stainless pipe is dimensionally accurate and furnished with superior I.D. surfaces.

MEETS RIGID PIPING REQUIREMENTS



SIZE RANGE AND COMPOSITION FLEXIBILITY

Outside Diameter—6" to 50"
Wall Thickness—⅛" and up
Length—Up to 16'
Types of Stainless—All Standard AISI and ACI grades of ferritic and austenitic stainless, including No. 20 Alloy, 17-4 P H, 17-7 P H and E.L.C. grades.

UNITED STATES PIPE & FOUNDRY CO.

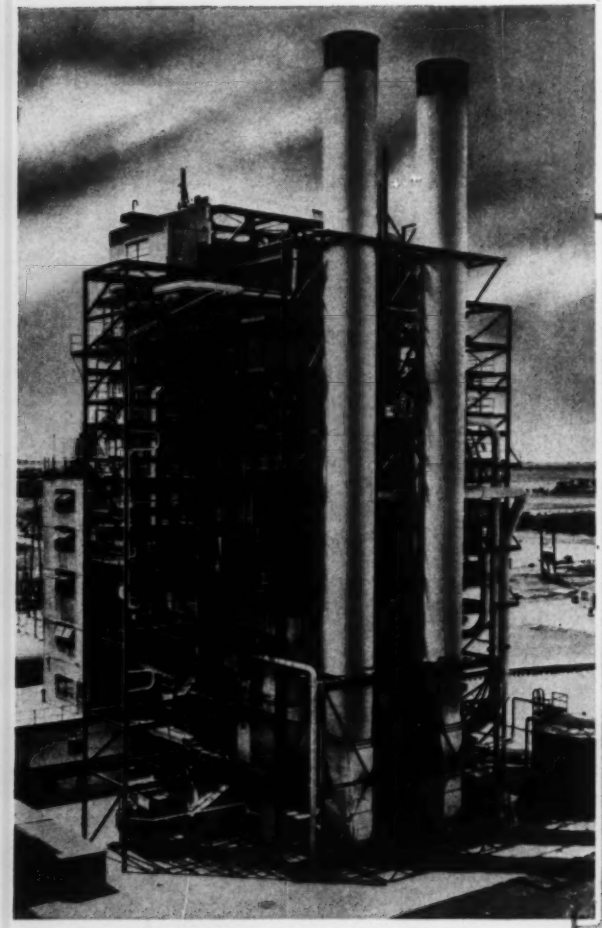
Steel and Tubes Division

BURLINGTON, NEW JERSEY

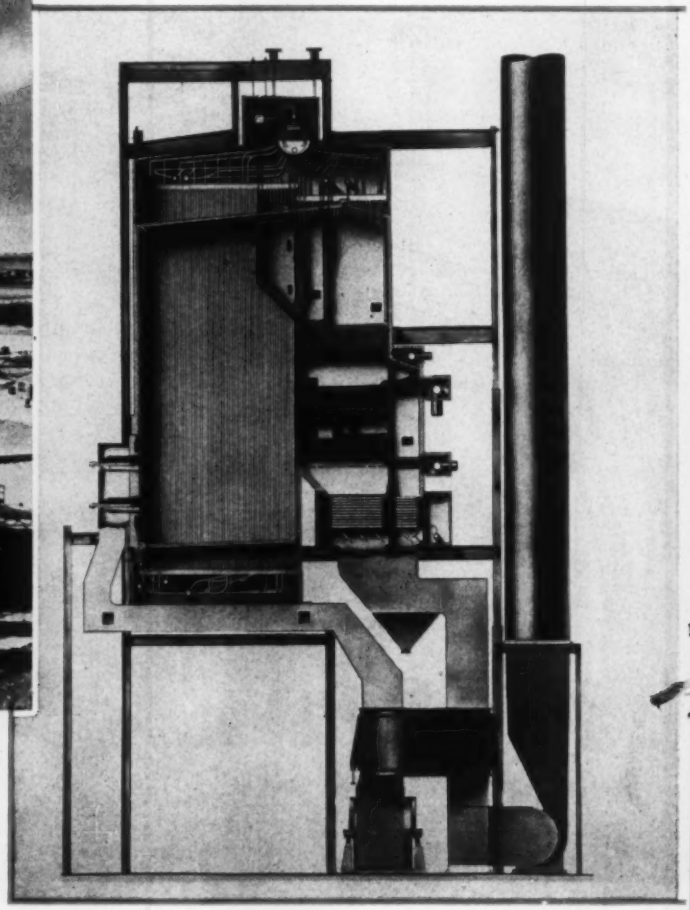
SALES OFFICES: LOS ANGELES, SAN FRANCISCO, CHICAGO, ST. LOUIS, COLUMBUS, DETROIT, PITTSBURGH, HARTFORD, BURLINGTON

Kansas Gas and Electric puts third*
FW steam generator "on the line" to help . . .

MEET GROWING DEMAND



*A fourth FW steam generator, of 800,000 lb per hr capacity is now on order for the Murray Gill Station.



Foster Wheeler steam generator, unit no. 3, at the Murray Gill Station of the Kansas Gas and Electric Co. just southwest of Wichita, Kansas. A Foster Wheeler 65,000 sq ft surface condenser of the double-flow type serves the 115,000 kw turbine.

Cross-section of the reheat unit shows arrangement of furnace with space provided for possible future conversion to coal firing.

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

ON MURRAY GILL STATION

Of outdoor design, this 800,000 lb per hr Foster Wheeler reheat steam generator supplements two other FW units of 425,000 and 625,000 lb per hr capacity serving this modern central station.

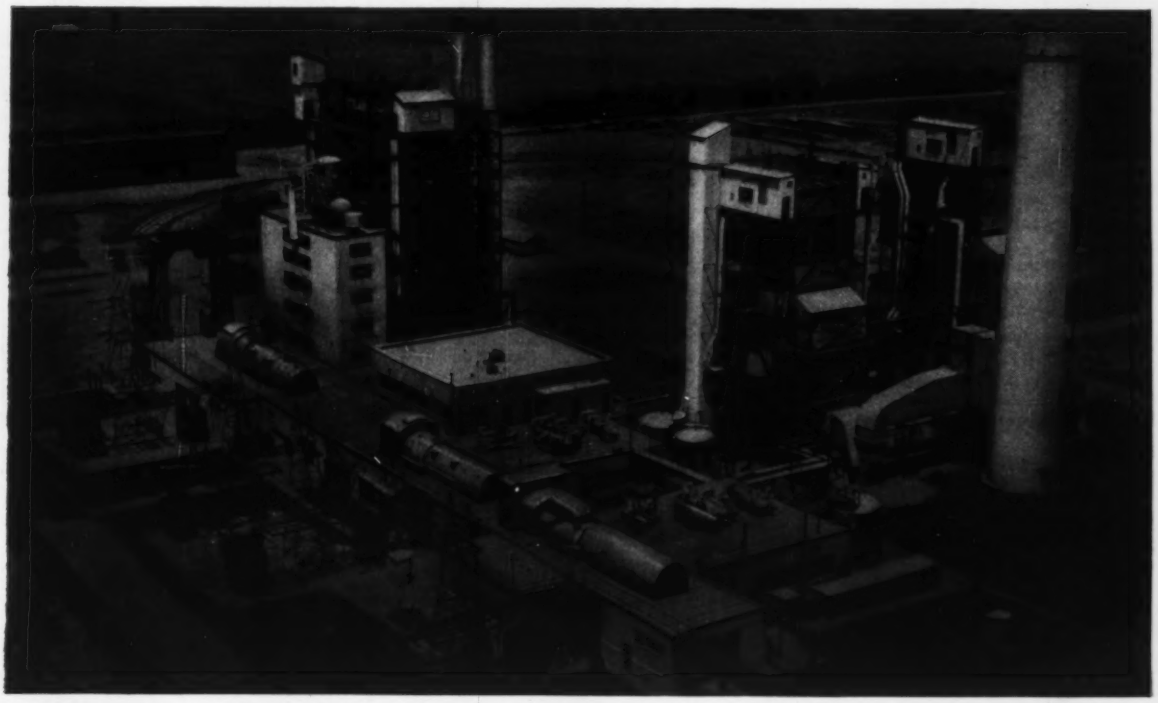
CUSTOMERS of Kansas Gas and Electric Company are consuming more and more electric power. The greater use of electric appliances in the home, increased commercial business, enlarged industrial production – all are resulting in an ever-growing demand on the company's facilities.

And at the Murray Gill Station, the company's newest and most efficient operation, with a total generating capability of 240,000 kw, three Foster Wheeler steam generators are now helping meet this upward trend.

The third FW unit to be installed at Murray Gill went into service in April of 1956 – 20 months after placing of contract. It has a capacity of 800,000 lb steam per hr with corresponding reheater flow of 692,000 lb per hr and steam outlet conditions of 1005 F/1005 F and 1925 psig at the superheater outlet.

Repeat orders like this represent a positive expression of confidence in Foster Wheeler steam plant equipment. With more than fifty years of experience in steam generation – and the finest modern manufacturing facilities in three large plants – Foster Wheeler welcomes the opportunity to quote on your requirements. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

Aerial view of Murray Gill Station of KG&E, showing outdoor-type reheat steam generator at left and FW dual circulation units at right.



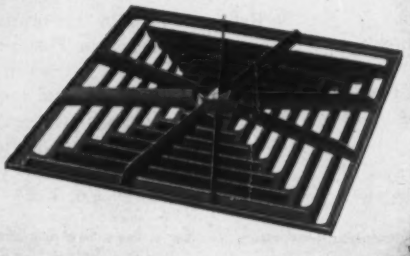
American Blower Vertical Unit Heaters offer you

Air-flow control with Equitemp Air Diffusers

Capacities: 58,400 to 560,000 BTU at 2 lbs. steam pressure, 60° entering air.

VERTICAL UNIT HEATERS

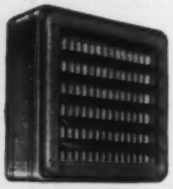
Adjustable Equitemp Air Diffuser lets you tailor heat flow to the job.



Equitemp Air diffusers are *standard equipment* on American Blower Venturafin Vertical Unit Heaters. Extremely versatile, this unique air diffuser lets you control heat distribution at all mounting heights by simple hand adjustment.

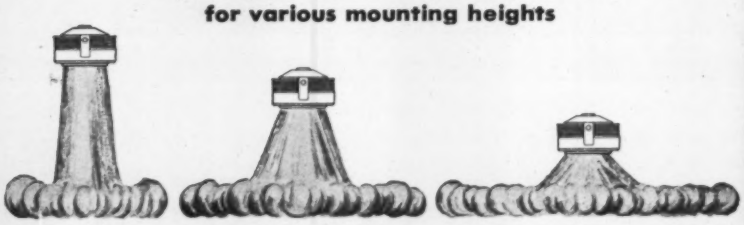
At low mounting heights, for example, the Equitemp Diffuser can be adjusted to eliminate the blast of heated air that so often bothers employees directly beneath. Yet, for high-ceiling mountings, diffuser vanes may be left in vertical position for maximum blow. Anemostat and vane-type diffusers also available.

Select low-cost, quiet-operating Venturafin Unit Heaters for *your* next job. For data, consult your nearest American Blower Branch Office. Do it, today!



For applications requiring heaters with horizontal blow, American Blower offers a wide selection. Capacities: 18,000 to 357,500 BTU at 2 lbs. steam pressure, 60° entering air.

Equitemp Air Diffusers are adjustable for various mounting heights



High ceilings Medium ceilings Low ceilings

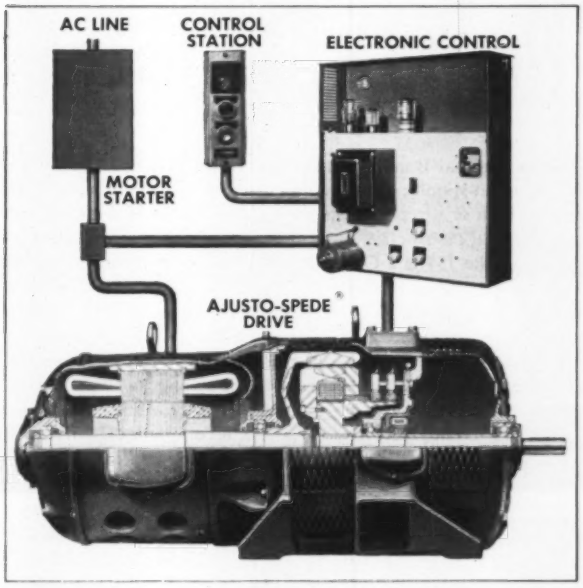
Other American Blower Unit Heaters

American Blower's gas-fired unit heaters and de luxe cabinet heaters for commercial and industrial use are compact, efficient and easy to install.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American-Standard

AMERICAN BLOWER

SPEED CONTROL BY



DYNAMATIC®

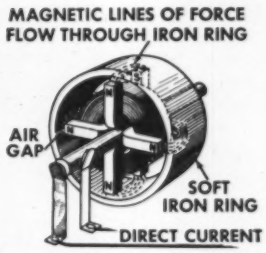
How it Works — What it Does — Why it's Better

Increased production, reduced costs, improved quality of product, and more complex processing techniques demand an ever increasing use of stepless adjustable speed drives. Dynamatic eddy-current equipment in one form or another attains these objectives.

Dynamatic Ajusto-Spede® Drives, Air and Liquid Cooled Couplings, Air and Liquid Cooled Brakes, Absorption, Motoring, and Universal Dynamometers operate on the same basic electro-magnetic principle.

A typical installation pictorially illustrates the simplicity and minimum components required to obtain controlled adjustable speed.

Basic Principles of Operation



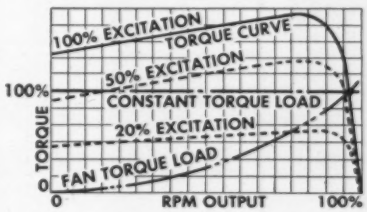
The transmitting of torque by Dynamatic eddy-current devices is based upon a simple magnetic principle easily demonstrated by the physics experiment, using a horseshoe magnet, iron filings, and a piece of cardboard. If several unmagnetized soft iron bars in the shape of a U, illustrated in the above drawing, are inserted in an insulated coil of wire, the bars will become magnets when direct current flows through the coil. Strength of the magnetic field is determined by the current flowing and the number of turns in the coil. By adding a solid ring of soft iron, encircling the poles of the electromagnets, the magnetic lines of force will flow through the ring. The basic construction of all Dynamatic eddy-current rotating equipment is then simulated.

The illustration shows magnetic lines of force with no relative rotation between the ring and magnets. When the field assembly (magnets and coil) is rotated mechanically, the iron ring separated from it by a nominal air gap remains stationary until current is applied to the coil. With the coil energized, mechanical rotation of the magnets produces movement of magnetic flux in the ring, creating eddy-currents in the ring. These induced currents develop a second magnetic field. Its strength is determined by the strength of the primary field and the relative speed difference (slip) between the two members. In the eddy-current coupling, attraction of these two fields cause the ring to follow the field magnets in rotation. When the coil current is varied, the eddy-currents will be proportionately affected, and torque produced at the output shaft will be similarly changed.

A typical eddy-current coupling torque curve with rated excitation and additional curves with reduced excitation is shown. In the same figure, a constant torque and fan torque load curve is plotted. Excess torque, which is a measure of accelerating capacity, is indicated. The Dynamatic coupling transmits this torque from a driving member, that may be either the drum ring or field magnets, to a driven member without mechanical contact.

Because of the extremely small excitation requirements, Dynamatic units lend themselves readily to electronic or magnetic amplifier control.

By taking advantage of the very high amplification factor of these controls, the largest couplings can be easily and conveniently controlled with a small adjusting potentiometer. The voltage output of a permanent magnet alternator mounted on the coupling output shaft varies directly with the shaft speed. This variable voltage signal modulates the control, automatically maintaining the selected speed of the coupling output shaft, within close limits, over a wide speed range.



Other features are easily incorporated—constant tension, controlled acceleration, threading, jogging or inching, torque limit, speed matching, and many others.

The relative simplicity, smoothness of operation, accuracy, ease of control and low maintenance of Dynamatic eddy-current equipment are factors meriting serious consideration of this type of equipment on almost all adjustable speed applications.

A free copy of the Dynamatic General Bulletin describing eddy-current equipment in more detail is available. Write for your copy.

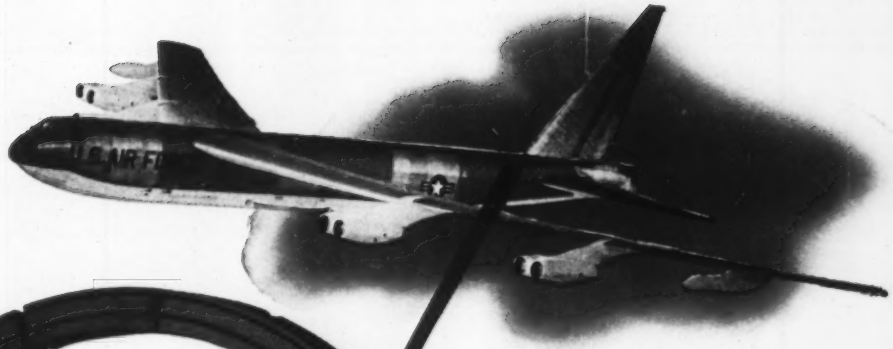
EATON — DYNAMATIC DIVISION
MANUFACTURING COMPANY
3307 FOURTEENTH AVENUE • KENOSHA, WISCONSIN

GRAPHITAR® is the main shaft seal
(CARBON-GRAPHITE)
PRATT & WHITNEY J57 turbojet

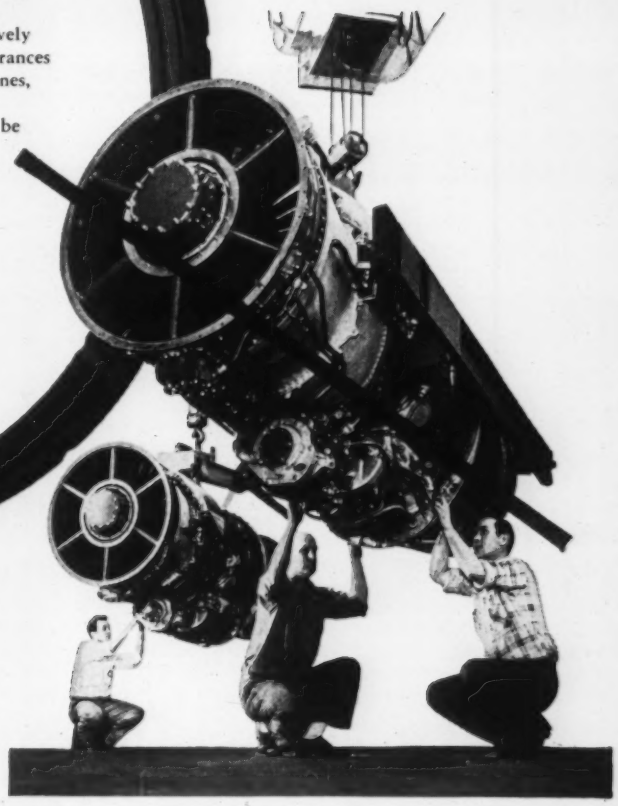
● Boeing's B-52 Intercontinental Bomber, the striking arm of our Strategic Air Command, is powered by eight twin-spool axial-flow turbojet engines manufactured by the Pratt & Whitney Aircraft Division of United Aircraft Corporation, East Hartford, Connecticut. These turbojets are in the 10,000 pound thrust class and in engines of this caliber, complete dependability is vital. One of the components of the J57 is a GRAPHITAR air/oil seal employed on the turbine main shaft which, naturally, is turning at high speeds. The GRAPHITAR seal also easily withstands the maximum operating pressures developed in the engine. The slots in the face of the seal shown on the opposite page (approximately ⅔ size) are for pressure balance and cooling. This Main Shaft Seal is just one of several GRAPHITAR seals used in the J57 engine. GRAPHITAR parts can resist such taxing physical conditions because they are strong, self-lubricating, and practically inert. GRAPHITAR has excellent wearing properties and cannot be corroded by most chemicals. Where the application is tough and complete dependability [illegible] material to specify.

THE UNITED STATES

in the engine



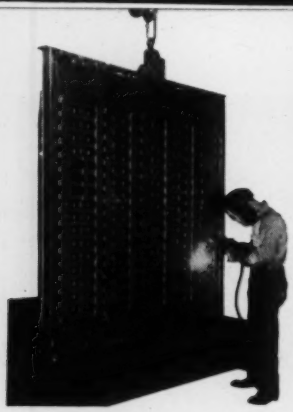
● From the B-52 to the atomic submarine Nautilus, from automobile pumps to automatic toasters, GRAPHITAR is aiding the performance of literally hundreds of highly diverse products. This versatile engineering material is compacted under extreme pressure and fused at heats near 4500°F. It can be formed in relatively complicated shapes and ground to tolerances as close as .0005" for seals, bearings, vanes, piston liners, and many other parts. GRAPHITAR is self-lubricating . . . can be used where only steam or water are present. It is lightweight, strong, durable, chemically inert, and is virtually unaffected by extremes of heat, pressure, or temperatures.



write for your copy of the new GRAPHITAR Engineering Bulletin No. 20

GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN



WELDING SOLVES ANOTHER

and USS "T-1" Steel solves the welding problem!

Bedplates for modern color-printing presses have to be rugged—but as lightweight as possible. They must withstand constant pounding from printing rollers and cutting knives. And, since they move back and forth continually, they've got to be lightweight for fast, efficient operation. It is a good place to use a welded assembly of steel plates.

But that's where Graver Tank & Manufacturing Co., Inc., ran head-on into a tough fabrication problem. Alloy steel with the necessary strength and durability was difficult to weld. And with 534 welds on *every* bedplate, this was a king-size headache.

NO MORE HEADACHE!

Now the headache is gone. Production costs are down. And the finished bedplates are working hard and long . . . taking a tremendous daily pounding without distortion.

The solution? Just a switch to a remarkable *new* alloy steel, USS "T-1" Steel.

"T-1" Steel is very strong. Very tough. Able to take vicious impact abuse. Yet, it's easy to weld, "says Mr. H. McDonald, Superintendent at Graver."

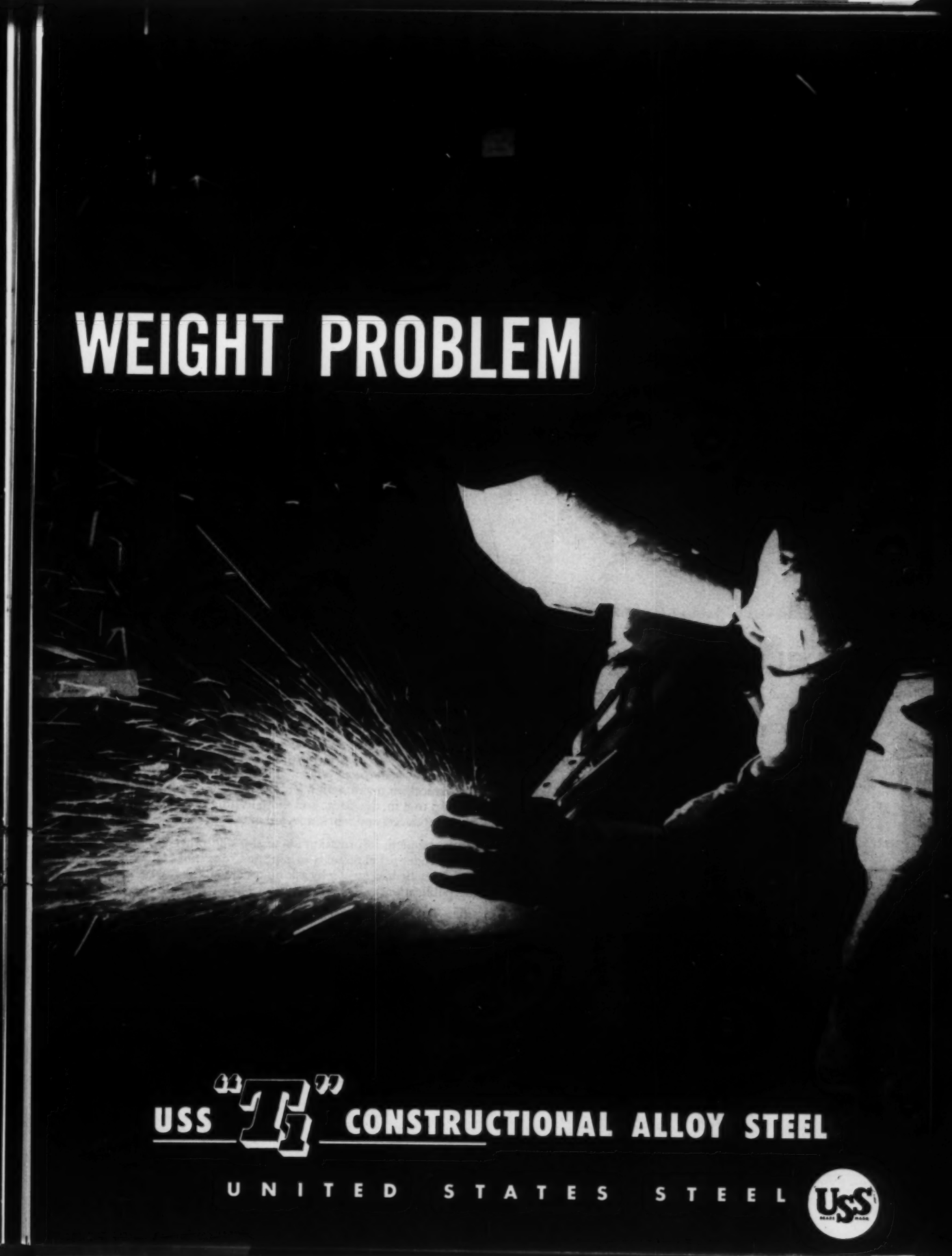
HOW ABOUT YOU?

If you have tough jobs, rugged jobs, where you want to weld your way to lower costs, give this new steel a try. We think you, like Mr. McDonald, will find it the best thing you have ever used. Right now, "T-1" is in service and doing well in bridges, power shovels, steam turbines, electrical transformer tanks, flywheels, pressure vessels, mine cars, and lots of other places. Write for details. United States Steel, Room 5535, Pittsburgh 30, Pa.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

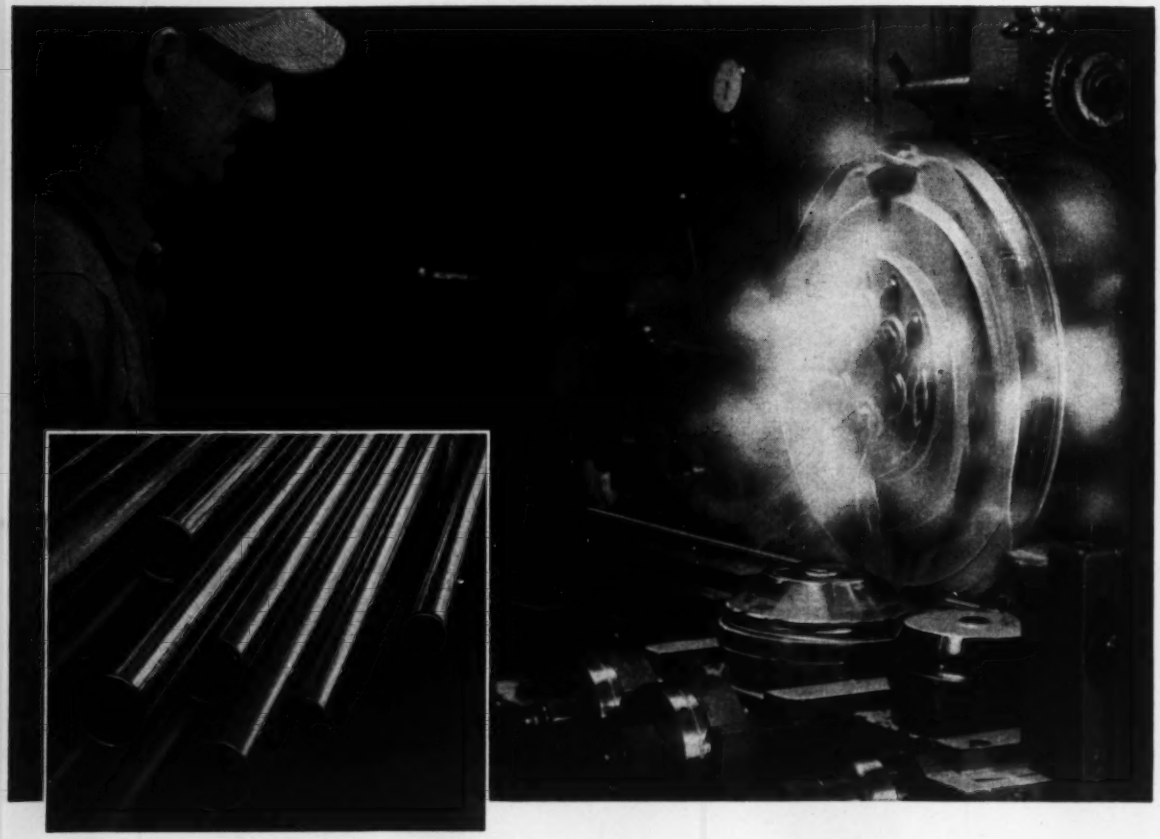
"TOP QUALITY!" That's how Graver Tank & Manufacturing Co., Inc., East Chicago, Indiana, describes new USS "T-1" Steel. It gives them a yield strength of 90,000 psi . . . exceptional resistance to impact abuse . . . and good weldability. It enables them to build extremely rugged, all-welded bedplates for printing presses.

WEIGHT PROBLEM



USS "T1" CONSTRUCTIONAL ALLOY STEEL

UNITED STATES STEEL



IN ELECTRIC-WELD PIPE AND TUBE MAKING

Yoder leads the way

to higher speeds and quality at lower cost

In the short period from 1938 to 1955, the production of electric welded pipe and tubing grew from 269,000 tons to over 3,000,000 tons. This phenomenal rate of growth—over two and one-half times faster than that of the pipe and tube making industry as a whole—to a large extent resulted from a series of important improvements in tube mill design, all introduced by Yoder.

First came the Yoder rotating welding transformer, in 1938. The economic and other benefits conferred by this epoch making innovation were further augmented by other technological advances scored by Yoder in the years that followed. The result was that electric-weld pipe and tube making became the child prodigy of the fast growing pipe and tube making industry.

Latest, and perhaps the greatest, of these developments is the cold forming and induction welding at high speeds of *aluminum, magnesium, brass, nickel, monel, and other non-ferrous metals and alloys.* This process is especially economical for making light and medium gauge tubes in sizes up to 8 in. dia. More and more leading non-ferrous metal producers and fabricators are installing these mills.

More complete information about this and other interesting Yoder developments in pipe and tube mill equipment may be had merely by asking for any of the following publications:

- ☐ Resistance-Weld Mills for making Steel Tubing up to 4" diameter.
- ☐ Induction-Weld Mills for making Non-ferrous Tubing.
- ☐ Resistance-Weld Mills for Steel Pipe up to 24" diameter.

THE YODER COMPANY

5499 Walworth Avenue **Cleveland 2, Ohio**

ENGINEERING YODER MANUFACTURING

PIPE AND TUBE MILLS—Electric Weld

ROTARY SLITTING LINES

COLD ROLL FORMING MACHINES

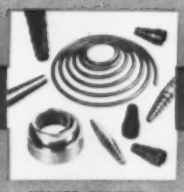
60 second tour

shows it in a nutshell . . .

All-Inclusive Spring Service

COMPRESSION SPRINGS
Regular, Double

COMPRESSION SPRINGS
Special Shapes
Variable pitch

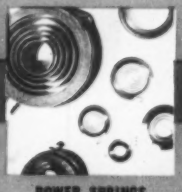


VOLUTE SPRINGS
Coned end

EXTENSION SPRINGS
Special Hooks
and Loops

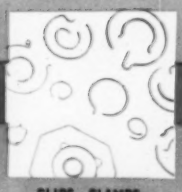
EXTENSION SPRINGS
Swivel End
Drawbar

TORSION SPRINGS
Single, double
Edge wound



POWER SPRINGS
Clock or Motor

FLAT SPRINGS
Arched, Curved-beam
Elliptical



CLIPS, CLAMPS
and COLLARS

FASTENERS and
RETAINERS

HAIRSPRINGS
for Instruments
Gauges, etc.

SPRING WASHERS
Wavy, Star, Finger,
Expander, etc.

BELLEVILLE SPRINGS
In Series, Parallel
Parallel-series

DIAPHRAGMS
Discs, Plates

PLUS
COLD-ROLLED
SPRING STEEL

WALLACE BARNES COMPANY
BRISTOL, CONNECTICUT

THE WILLIAM D. GIBSON COMPANY
1800 CLYBOURN AVE.
CHICAGO 14, ILL.

RAYMOND Manufacturing COMPANY
CORRY, PENNSYLVANIA

BARNES-GIBSON-RAYMOND
40300 PLYMOUTH RD.
PLYMOUTH, MICH.

B-G-R COOK PLANT
ANN ARBOR
MICHIGAN

DIVISIONS OF
ASSOCIATED SPRING CORPORATION
COAST TO COAST

SEABOARD Coil Spring Div.
15001 S. BROADWAY
GARDENA, CALIF.

OHIO DIVISION
1885 EAST FIRST ST.
DAYTON, OHIO

WALLACE BARNES COMPANY
STATE FAIR BLVD.
SYRACUSE 9 (Salina), N.Y.

MILWAUKEE DIVISION
341 E. ERIE ST.
MILWAUKEE, WIS.

DUNBAR BROTHERS COMPANY
BRISTOL, CONN.

F. N. MANROSS AND SONS CO.
BRISTOL
CONNECTICUT

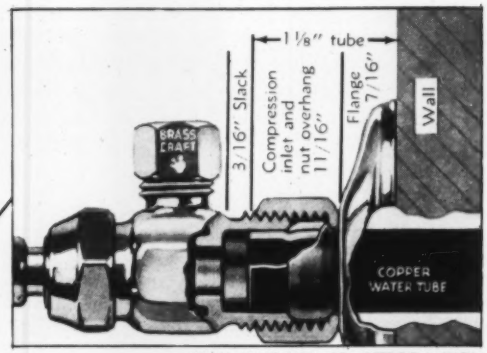
THE WALLACE BARNES CO., LTD.
HAMILTON
CANADA

Divisions of

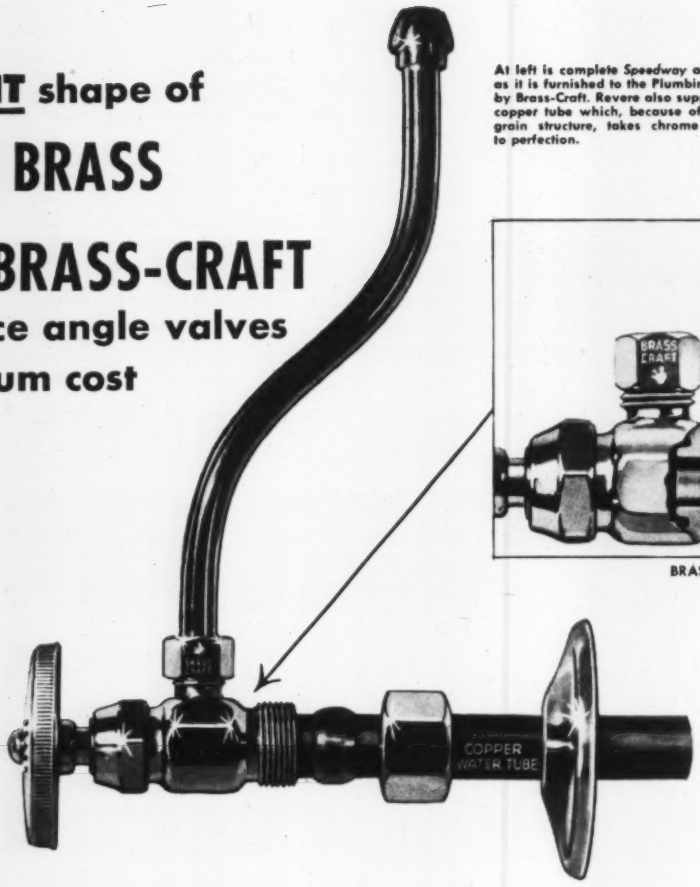
ASSOCIATED SPRING CORPORATION

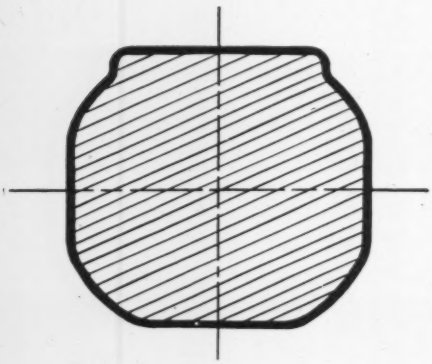
The **RIGHT** shape of
REVERE BRASS
enables BRASS-CRAFT
to produce angle valves at minimum cost

At left is complete Speedway assembly as it is furnished to the Plumbing Trade by Brass-Craft. Revere also supplies the copper tube which, because of its fine grain structure, takes chrome plating to perfection.



BRASS-CRAFT MFG. CO., DETROIT 1, MICH.





Cross section of Revere Brass Shape used in fabricating angle valves. Corners are rounded for easy buffing, leaving sufficient surface area for wrench pad. Top is made flat for speedy insertion of outlet.

Brass-Craft Manufacturing Company, manufacturers of Speedway Supplies, Valves & Fittings, considered two factors in selecting the Brass Shape of its angle valves.

1. Fabrication from the standpoint of production.
2. Installation and performance of the valve in use.

The shape at the left was found to be "*right*" from a production standpoint. Brass-Craft preferred it because it was nearest to the finished shape, saving metal, as well as extra cutting and machining. The fine grain structure of Revere Brass makes it especially easy to cut, drill, thread, buff and plate. Its "*right*" shape permits fabricating the valves into assemblies which save installation time. In this way, Brass-Craft is able to produce a high-quality product at minimum cost.

In addition, these brass valves resist corrosion and are compatible with copper water tube. Thus they have ready acceptance with plumbing and building contractors, as well as home owners.

Once again it is proved that there is one "*right*" product for every application. A Revere T. A. (Technical Advisor) is available to help you get the one best for you. He is always ready to cooperate in seeking ways to save money and improve your product. Call or write today.

COPPER ★ BRASS ★ 18 01 ★ REVERE ★ ALUMINUM

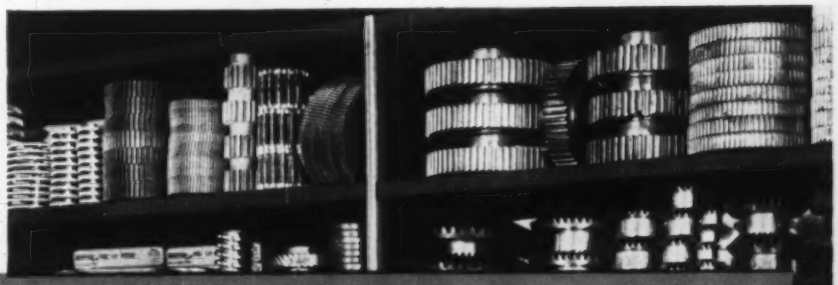
REVERE COPPER & BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

Mills: Baltimore, Md.; Brooklyn, N. Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

When you plan for COST REDUCTION — use this time-proved FORMULA



Selection from the **BOSTON Gear CATALOG** All the parts you need from the complete line of 7124 STANDARDIZED PRODUCTS

+

Ordering from your local **BOSTON Gear DISTRIBUTOR** anywhere in U. S. or Canada for prompt delivery OFF-THE-SHELF- AT FACTORY PRICES

=

Trouble-free . . . cost-wise **TRANSMISSION** design and maintenance **ECONOMY**

- You simplify planning
- You save time and expense
- You get recognized top-rating in quality and performance

Get the NEW Catalog No. 56

576 PAGES — lists all products

You'll find hundreds of new products, new models, new sizes — and 50 pages of simplified Engineering Data to help you plan new efficiency, new economy in any transmission hookup. Boston Gear Works, 66 Hayward Street, Quincy 71, Massachusetts.

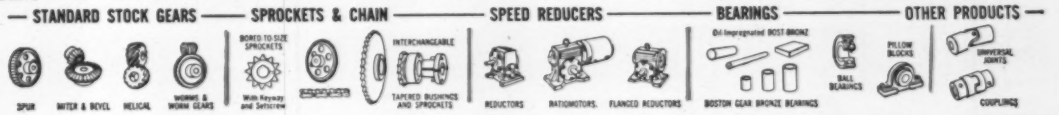
BOSTON Gear is right here!

CALL YOUR BOSTON Gear DISTRIBUTOR

For nearest Distributor, look under "GEARS" in the Yellow Pages of your Telephone Book.

7124 "OFF-THE-SHELF" TRANSMISSION PRODUCTS FROM STOCK - AT FACTORY PRICES ASK FOR CATALOG

— STANDARD STOCK GEARS — SPROCKETS & CHAIN — SPEED REDUCERS — BEARINGS — OTHER PRODUCTS —



56BG-NC-25A

Photo courtesy of the Norton Company, Worcester, Mass.

Variac® Motor Speed Control

for Full Torque at Any Speed

In developing their new Rokide heat-resistant coatings for jet engines and rockets, engineers of the Norton Company found they needed a motor control which would provide smooth, continuous speed control with constant-output torque . . . particularly at the very-low speeds. The effectiveness of the ceramic-spray process depends to a considerable extent on the correct rate and evenness of feed of the ceramic rod passing into the spray gun.

> Variac Motor Speed Controls were chosen for this work because: "This was the only equipment we were able to find which would permit our motors to run at very-low speeds without losing their torque. Pulsations could not be tolerated and, because the equipment would operate for long periods at a time, the equipment had to be reliable in operation."

General Radio Motor Controls are built for just this kind of service. They are widely used where stringent specifications for performance and dependability require the very best in speed-control equipment. Typical of machinery whose operation is improved by the use of the versatile Variac Motor Speed Control are: high-speed grinders and drills, tapping machines, lathes, pumps, centrifuges, lapping machines, conveyors, coil winders, and all types of process machinery.

Inexpensive and Reliable

Variac Motor Speed Controls . . . provide adjustable speed operation of d-c motors from a-c lines, combining the convenience of a-c power with the excellent starting characteristics and good regulation of d-c shunt and compound-wound motors. Fifteen models cover motor ratings from less than 1/15 hp to 1½ hp; there is a choice of compact units for installation at the control point, or of basic stripped-down models for use by the original equipment manufacturer. Prices range from $67 to $380.

WIDE SPEED RANGE: can be varied smoothly from zero to top-rated speed with full torque and no instability or jumpiness.

EXTRA QUICK START-STOP-REVERSE: under heavy load conditions.

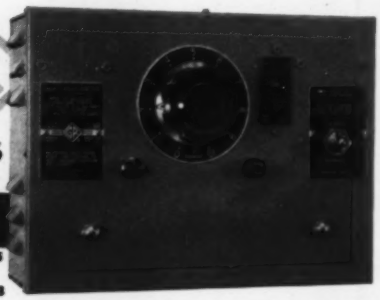
DYNAMIC BREAKING: on all larger models above 1/15 hp.

NO ELECTRON TUBES: selenium rectifiers make for ruggedness and reliability, require no warm-up time.

TROUBLE-FREE OPERATION: rugged design for long life; built-in overload protection prevents motor burnout.

CONSTANT TORQUE: rated horsepower delivered from full speed down to the stalling point; no torque pulsations.

Write For The Variac Motor Speed Control Bulletin for complete data



Variac® MOTOR SPEED CONTROLS

GENERAL RADIO Company 275 Massachusetts Avenue, Cambridge 39, Massachusetts

Broad Avenue at Linden, Ridgefield, N. J. **NEW YORK AREA**
1150 York Road, Abington, Pa. **PHILADELPHIA**
8055 13th St., Silver Spring, Md. **WASHINGTON, D. C.**
920 S. Michigan Ave. **CHICAGO 5**
1000 N. Seward St. **LOS ANGELES 38**

Bob Rossi, Chief Engineer, tells
Roy Johnson, Plant Manager

"We switched to Formbrite —and saved 12 cents apiece!"

.032" gage 70-30 Formbrite is used for this 4½" diameter rearview mirror head shown full size. Strip is 5 13/32" wide supplied in heavy coils for long press runs. Copper, nickel and chromium plating on a solid brass base provides a bright, rustless, long-lasting outdoor finish.

Peerless Rearview Mirrors. "Flight-Wing," below, and the newer "Director" model, left. Housings and mounts are chromium-plated zinc-base die castings.

This easy-to-polish, superfine-grain drawing brass has been slashing finishing costs in plant after plant, on all kinds of jobs. Now Peerless Accessories Co., of Mount Holly, N. J., reports:

"To our line of lighting and safety automotive accessories, we've recently added two rearview mirror assemblies. We had been using regular drawing brass for the dished head until your representative persuaded us to try Formbrite. Here are the results, based on a very careful cost study:

Finishing procedure using regular drawing brass	Present procedure using Formbrite®
1) Grease grinding or "cutting"	Not necessary with Formbrite
2) Buffing	Light buff
3) Copper strike	Copper strike
4) Nickel plate (.00045")	Bright nickel plate (.0003")*
5) Buffing nickel	Not necessary
6) Chromium plate	Chromium plate
Cost 27¢ each	**Cost 15¢ each**

"That's a saving of 12 cents apiece. Multiply it by 3,000 to 4,000 a day and it becomes important money!"

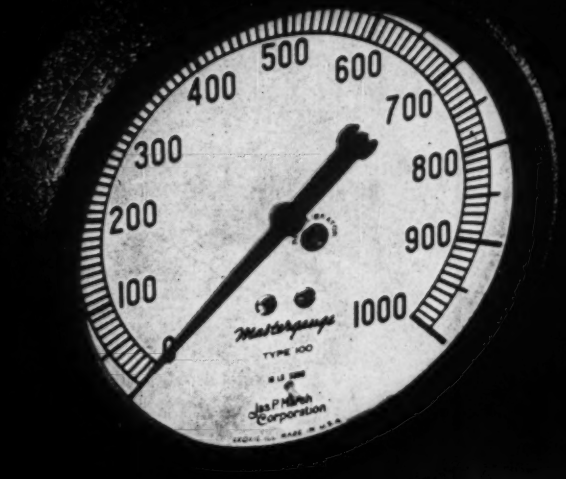
*Formbrite's superfine grain made possible a lighter but equally serviceable plate of bright nickel

Surprisingly, Formbrite doesn't cost a penny more. Find out for yourself how its superfine grain, excellent drawing properties, strength, and scratch resistance can help you make a better product at lower cost. Write for Publication B-39. Better yet, ask us about a sample lot. The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 5670

Formbrite FINE-GRAIN DRAWING BRASS

an ANACONDA® product
made by The American Brass Company

MARSH

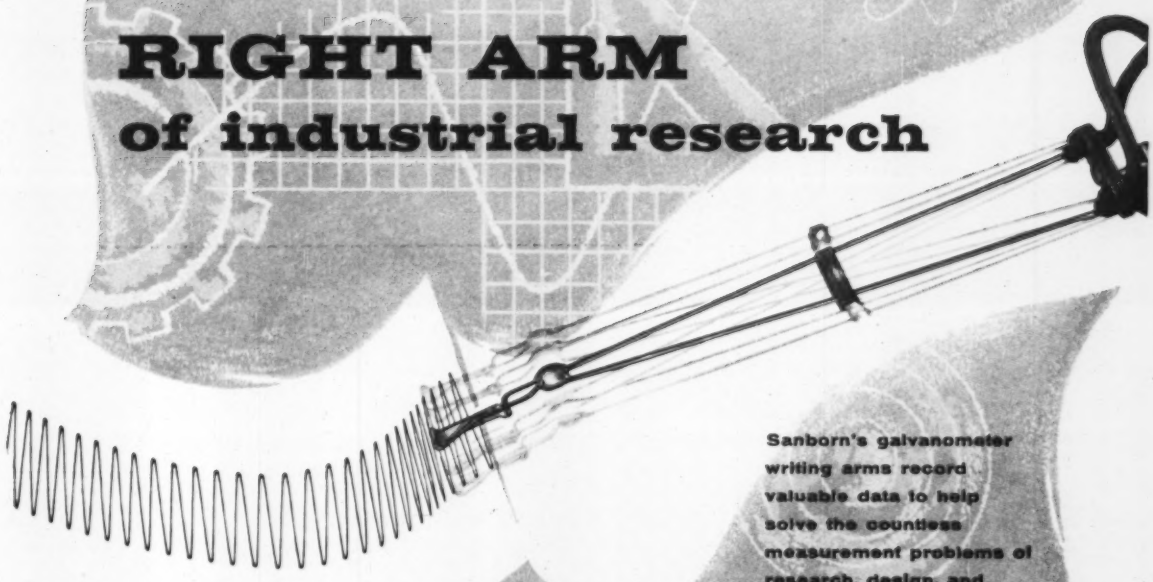


The world's finest pressure gauge

JAS. P. MARSH CORPORATION ● SKOKIE, ILLINOIS

"THE STANDARD OF ACCURACY"

RIGHT ARM of industrial research



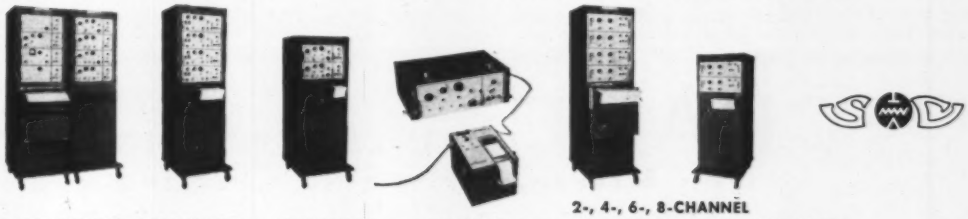
Sanborn's galvanometer writing arms record valuable data to help solve the countless measurement problems of research, design, and production testing.

SINGLE to 8-channel inkless and permanent recording in true rectangular coordinates of 0-100 cps phenomena — ranging from telemetered aircraft data to atomic reactor characteristics — is the vital and growing role of Sanborn oscillographic recording systems in industry. The Sanborn file of users indicates that such recordings are aiding in the dynamic analysis of jet engine starters, machine tools, agricultural machinery and oil drilling equipment; performance of pilotless target aircraft, modern submarines and tracking radar systems; and the production testing of servo components, valve positioners and precision potentiometers. Sanborn systems designed especially for recording analog computer output extend applications further — in simulated flight set-ups, solution of complex problems with six or eight variables, etc.

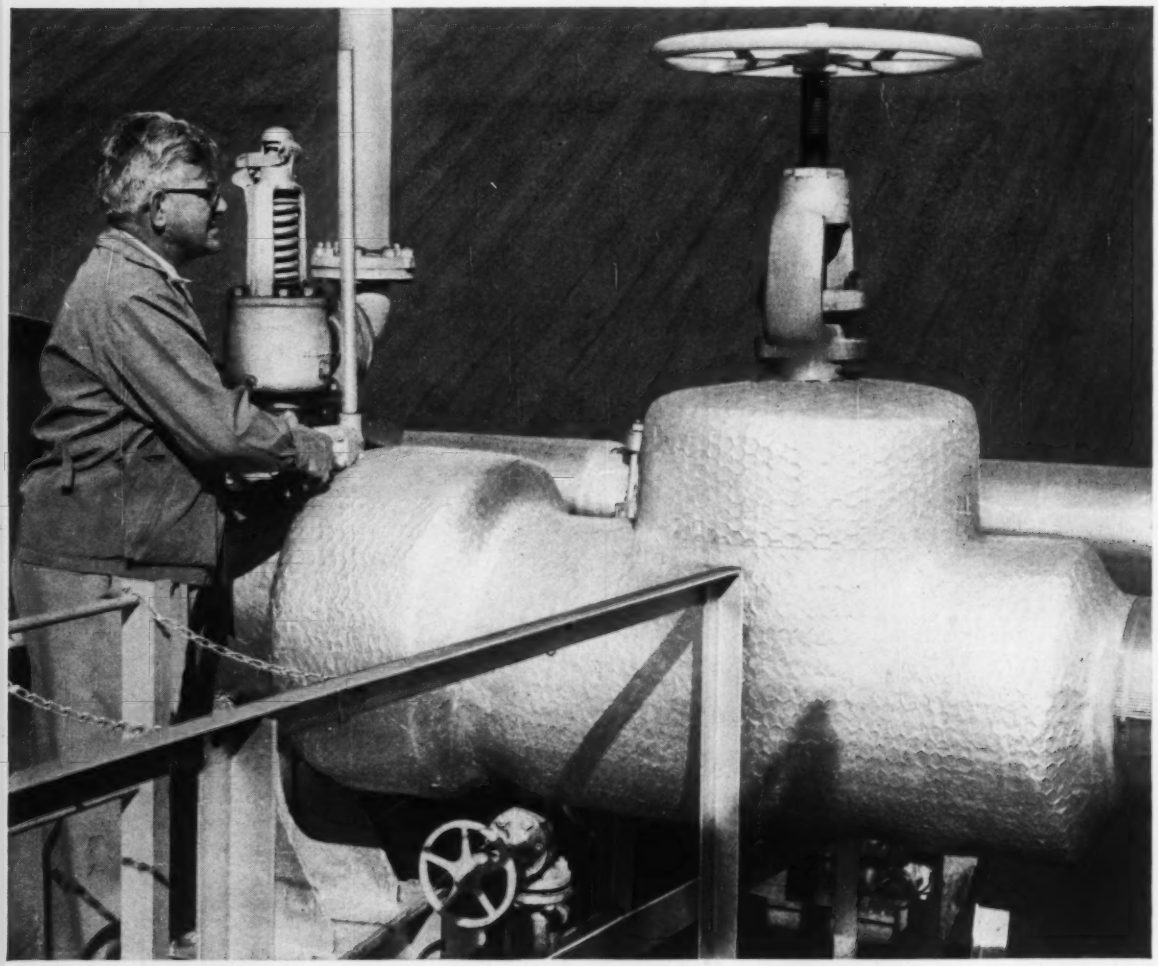
The advantages of making Sanborn equipment the "right arm" of *your* recording problems include extreme *flexibility*, by means of a dozen different interchangeable, plug-in "150 Series" preamplifiers which quickly and economically adapt a basic system to changing requirements; choice of 1-, 2-, 4-, 6- or 8-channel systems, in vertical mobile cabinets or "portably packaged"; numerous chart speeds, many individual channel controls, and high over-all system linearity.

To see how oscillographic recording the Sanborn way can become the "Right Arm" of *your* analysis work, write for detailed information or contact your Sanborn Representative. Sixteen-page "150 System" catalog on request.

SANBORN COMPANY
Industrial Division, Cambridge 39, Mass.



8-, 6- CHANNEL | 4-CHANNEL | 2-CHANNEL | 1-CHANNEL | 2-, 4-, 6-, 8-CHANNEL ANALOG COMPUTER SYSTEMS



This Crane valve has 20-year cost-free record on 400 psi. steam at 750° F.

Twenty years on this high-temperature steam boiler outlet service with never a wrench on it—that's valve performance in any man's language.

This Crane 8-inch No. 179U cast steel stop-check valve has racked up just such a record at Fort Bend Utilities Co., Sugar Land, Texas, and is working as smoothly today as it did two decades ago.

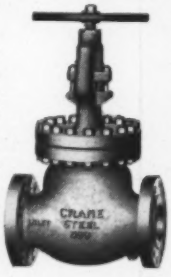
The Fort Bend Utilities plant—a subsidiary of the neighboring Imperial Sugar Co.—finds this Crane stop-check an important aid to boiler efficiency.

Its high-lift disc permits maximum flow-through, with minimum pressure drop under varying load conditions. Seating is instantaneous on back flow.

On manual closure, about once yearly for boiler servicing, the valve has never failed to respond smoothly and seat tightly.

To valve users experienced with Crane quality, this performance record is not so unusual. Thousands of Crane stop-checks throughout industry are giving similarly outstanding service.

The superior materials, the top-flight engineering and construction designed into all Crane valves give them service capacity and durability second to none.



Get these advantages next time you order valves: specify Crane and be *certain* of the valve service you want. Consult your local Crane Representative or write to address below.

CRANE VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

NOW!

OUTSTANDING CHEMICAL PROPERTIES

OUTSTANDING PHYSICAL PROPERTIES

VISTEX* with TEFLON** Gasketing Material

Another first for American! The exceptional thermal and chemical properties of Teflon are combined with low, cold flow characteristics to give you a gasketing material never before available.

DEFINITE ECONOMICAL ADVANTAGES

With thermal stability up to 420F. Vistex with Teflon eliminates undesirable lateral plastic flow with excellent stability to corrosive gases, liquids and virtually all chemicals at low and high temperatures.

Vistex with Teflon, with tensile strength of 5,000 psi, has very high tear value, will not ravel or fray, has very good cutting properties. Seals with minimum pressure on polished or irregular surfaces.

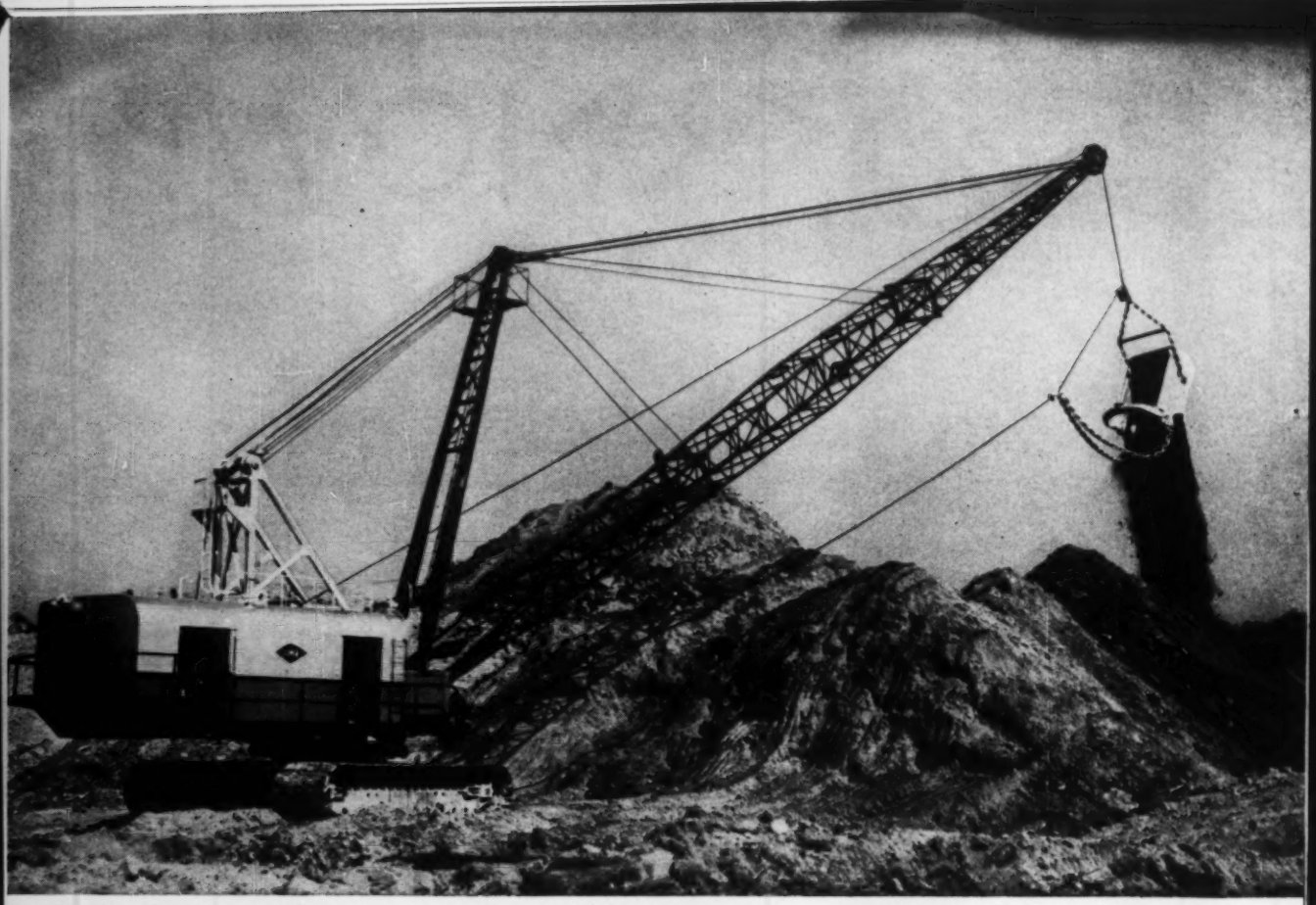
American's engineering and research staff is prepared to supply you with complete data and product recommendations. Write today on your company letterhead.

*VISTEX—Reg. Trade-mark of American Felt Company
**TEFLON—Reg. Trade-mark of DU PONT for its Tetrafluoroethylene resin.

American Felt Company
TRADE MARK

GENERAL OFFICES:
50 GLENVILLE ROAD,
GLENVILLE, CONN.

SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Greenville, S. C., Dallas, San Francisco, Los Angeles, Portland, San Diego, Seattle, Montreal.—PLANTS: Glenville, Conn.; Franklin, Mass.; Newburgh, N. Y.; Detroit, Mich.; Westerly, R. I.—ENGINEERING AND RESEARCH LABORATORIES: Glenville, Conn.



Lima Type 2400 shovel which incorporates a National Torque Converter. Here it is shown in use as a dragline with a 120-foot boom.

Where can you use NATIONAL Torque Converters?

National Torque Converters were developed specifically for the toughest, roughest industrial service. They are designed to provide a high degree of flexibility in operation of such equipment as power shovels, drag-lines, cranes, graders, shovel loaders, drilling rigs, mining and logging equipment.

In starting to move or lift a heavy load, a National Torque Converter acts as an automatic stepless transmission. Starts are smoother, easier . . . and acceleration of the load is faster. Result: more work per unit per operator per day.

Equipment is easier to operate and can be controlled more precisely. And there is less likelihood of overloading an engine or motor, or stalling it.

National Torque Converters are available in 6 basic hydraulic circuit sizes, each with a range of input ratings, permitting exact matching of torque converter to specific power-speed characteristics of a prime-mover. Precision fabrication of parts made to close tolerances assures uniform efficiency in operation, permitting standardization on your equipment.

Experienced National engineers are prepared to work with you on matching the right National Torque Converter to your requirements.

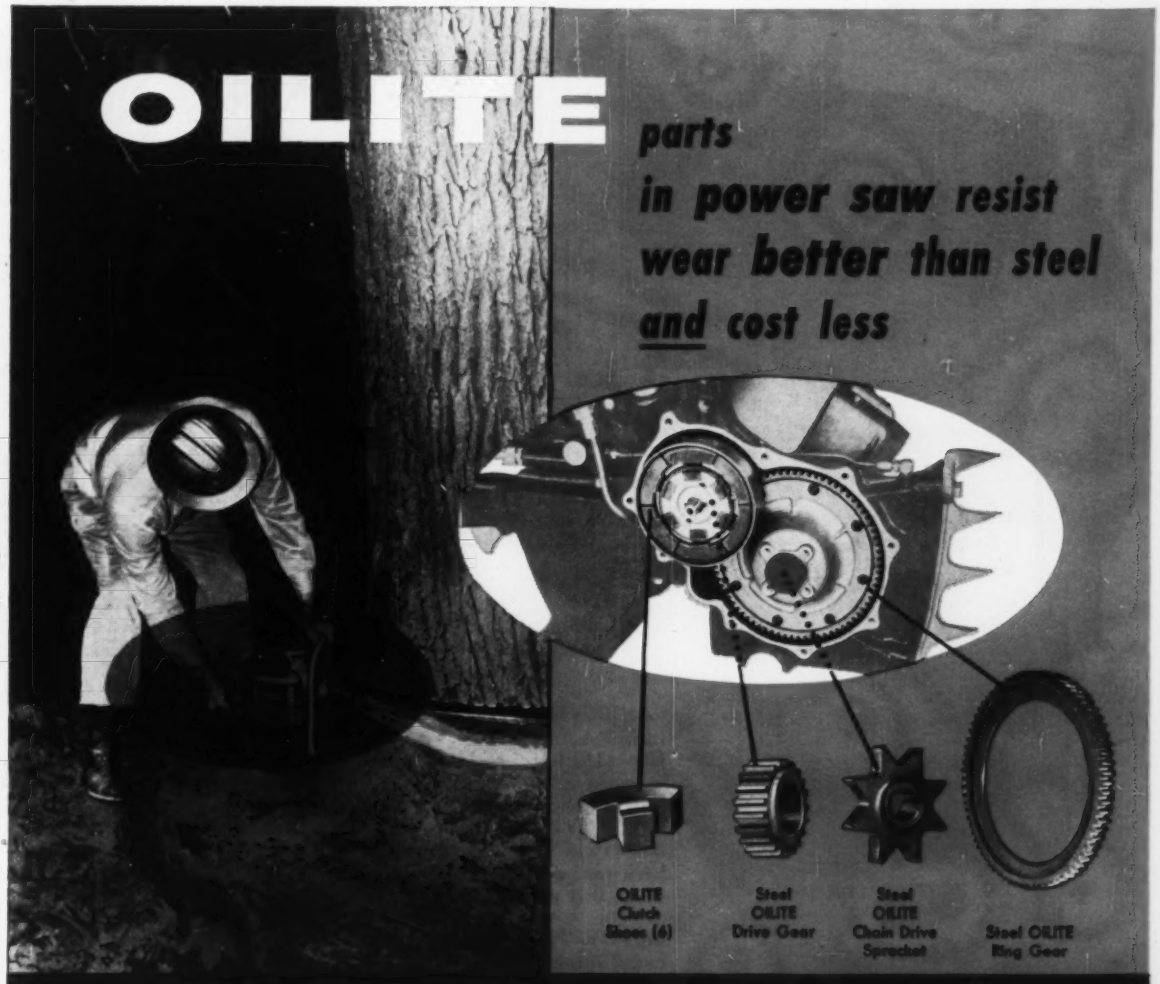
THE NATIONAL SUPPLY COMPANY

INDUSTRIAL PRODUCTS DIVISION

Two Gateway Center, Pittsburgh 22, Pa.

Pace-setters in the progress of industrial power transmission

OILITE parts in power saw resist wear better than steel and cost less



Another cost-saving application of **Amplex Powder Metallurgy**

With a modern power saw—easy does it. It's easier on the inside, too, because this manufacturer has equipped vital components with extra tough, greater wear resistant OILITE precision parts. The manufacturer's report indicates that OILITE powder metal sprockets and gears offer *greater wear resistance than alloy steels.*

Furthermore, in using OILITE precision parts the manufacturer of the power saw realizes *substantial cost savings over parts fabricated by any other process.*

What this manufacturer is accomplishing with OILITE precision parts, you can too. Or, perhaps, in your case OILITE self-lubricating bearings and bearing materials can help you lick the problem of providing lubrication in hard-to-get-at places. In permanent metal filters, too, OILITE provides a wide choice of shapes, sizes and porosities to meet product requirements.

Amplex—volume producer of Chrysler-engineered powder metal components—can meet your production schedules with on-time deliveries in any quantity.

Helping solve the problem of others is a daily occurrence at Amplex. This Chrysler-Amplex engineering service is available to you too.

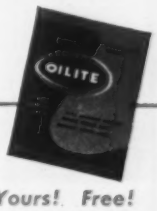
Representatives and dealers located in principal cities in United States and Canada.

A CHRYSLER OILITE PRODUCT

Only Chrysler Makes **OILITE**

AMPLEX DIVISION

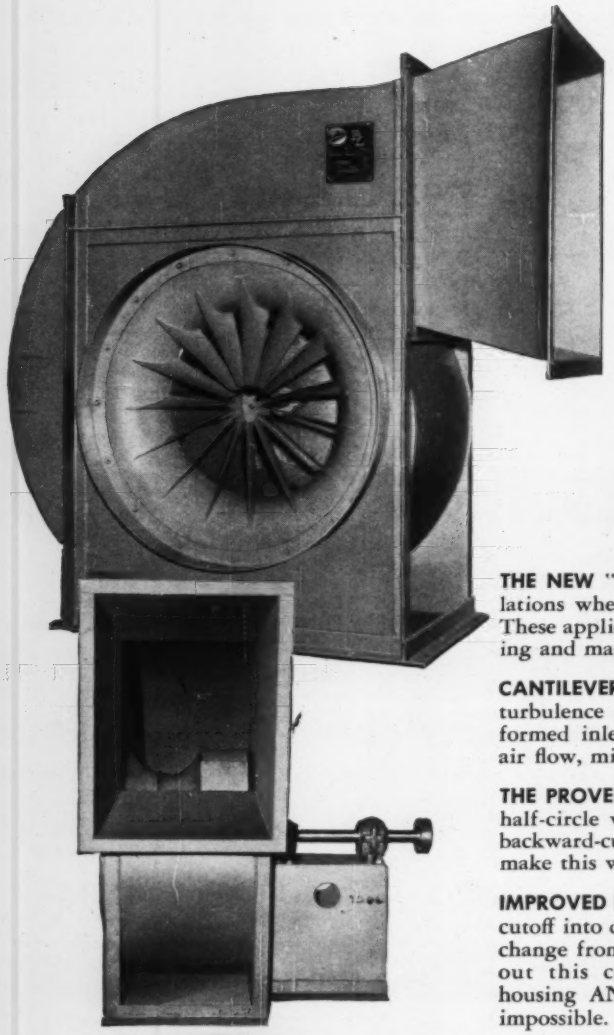
CHRYSLER CORPORATION • DETROIT 31, MICHIGAN



Yours! Free!

New 52-page OILITE Engineering Manual. Supplies valuable engineering data and application information on OILITE powder metal bearings, parts and filters. Ask for Manual E-56. Write: Dept. C.

Bearings • Finished Machine Parts • Permanent Metal Filters • Friction Units



NEW!

BUFFALO "BLH"

FOR CLASS II THRU IV VENTILATING-INDUSTRIAL & MECHANICAL DRAFT SERVICE

THE NEW "Buffalo" Type "BLH" FAN is engineered for installations where total pressure requirements of 3¾" and up exist. These applications include mechanical draft, conduit air conditioning and many industrial applications.

CANTILEVERED INLET VANES eliminate center ring, reducing turbulence and improving air flow through the inlet. The die-formed inlet vanes and inlet bell further contribute to smooth air flow, minimizing effects of unfavorable inlet conditions.

THE PROVEN BL WHEEL has a deep drawn flange to form a true half-circle with the inlet cone. Highly efficient non-overloading backward-curved blades, solid back plate and extra heavy hub make this wheel ideally suited to this service.

IMPROVED FAN OUTLET — reduces outlet air turbulence from fan cutoff into duct by making more even, gradual change from velocity to static pressure. Without this complete streamlining of inlet, housing AND outlet, such high efficiency is impossible.

Smooth Divergent Flow

86% MECHANICAL EFFICIENCY — made possible by a combination of inlet, wheel and housing design. The smoothest "air-ride" in fan history.

"Buffalo" "Q" FACTOR* CONSTRUCTION gives you many years of trouble-free service. Housing is all-welded construction. Wheel and blades are riveted and welded for maximum strength, the basic design having been thoroughly tested in the Vacuum Pit, a "Buffalo" exclusive.

AVAILABLE in wheel diameters from 18¼" to 80¾", the new "Buffalo" "BLH" merits your consideration. Write for details on your company letterhead — today.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

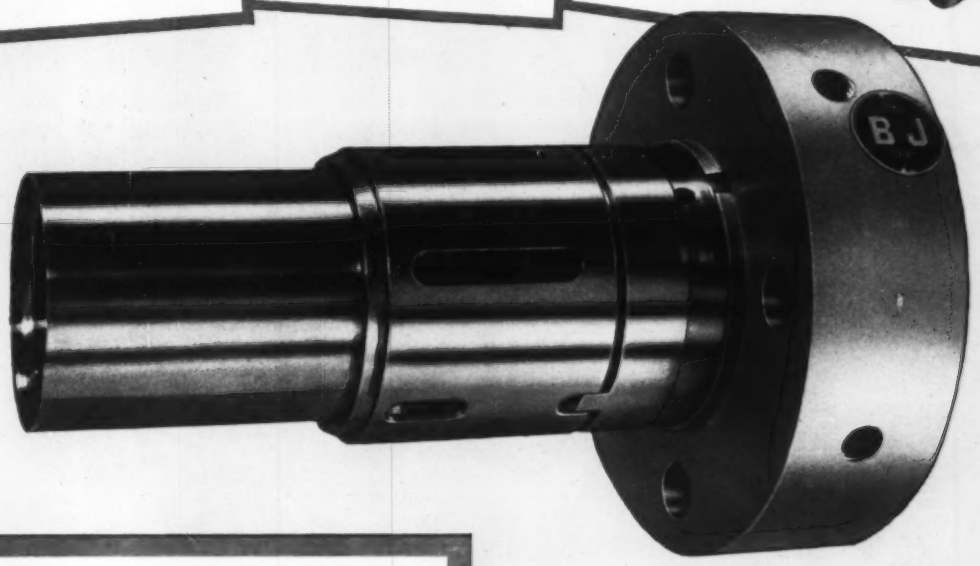
"Buffalo"

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

This ONE BJ Mechanical Seal...

Answers THREE Pumping Services...

With only the change of GASKETS!



1 **HIGH OR LOW TEMPERATURES**
The BJ *ASBESTOS* GASKETS handle temperatures from minus 100°F to plus 650°F.

2 **CORROSIVE**
The BJ *TEFLON* GASKETS answer a wide range of corrosive fluids.

3 **HIGH PRESSURE**
The BJ *RUBBER* GASKETS handle pressures to 1000 PSI . . . and any general service needs.

This *one* basic Byron Jackson Type U Mechanical Seal solves *three* major pumping services with only the change of two gaskets. You benefit because: (a) you can *standardize* on this basic BJ Type U Seal and thus greatly reduce your parts and inventory needs; (b) you can convert process pumps to changes of service with only the change of two gaskets; and (c) you *eliminate* costly, troublesome stuffingbox repacking and unnecessary pump downtime.

Only Byron Jackson . . . the leader in Mechanical Seals . . . offers this simplified interchangeability of service through a change of gaskets.

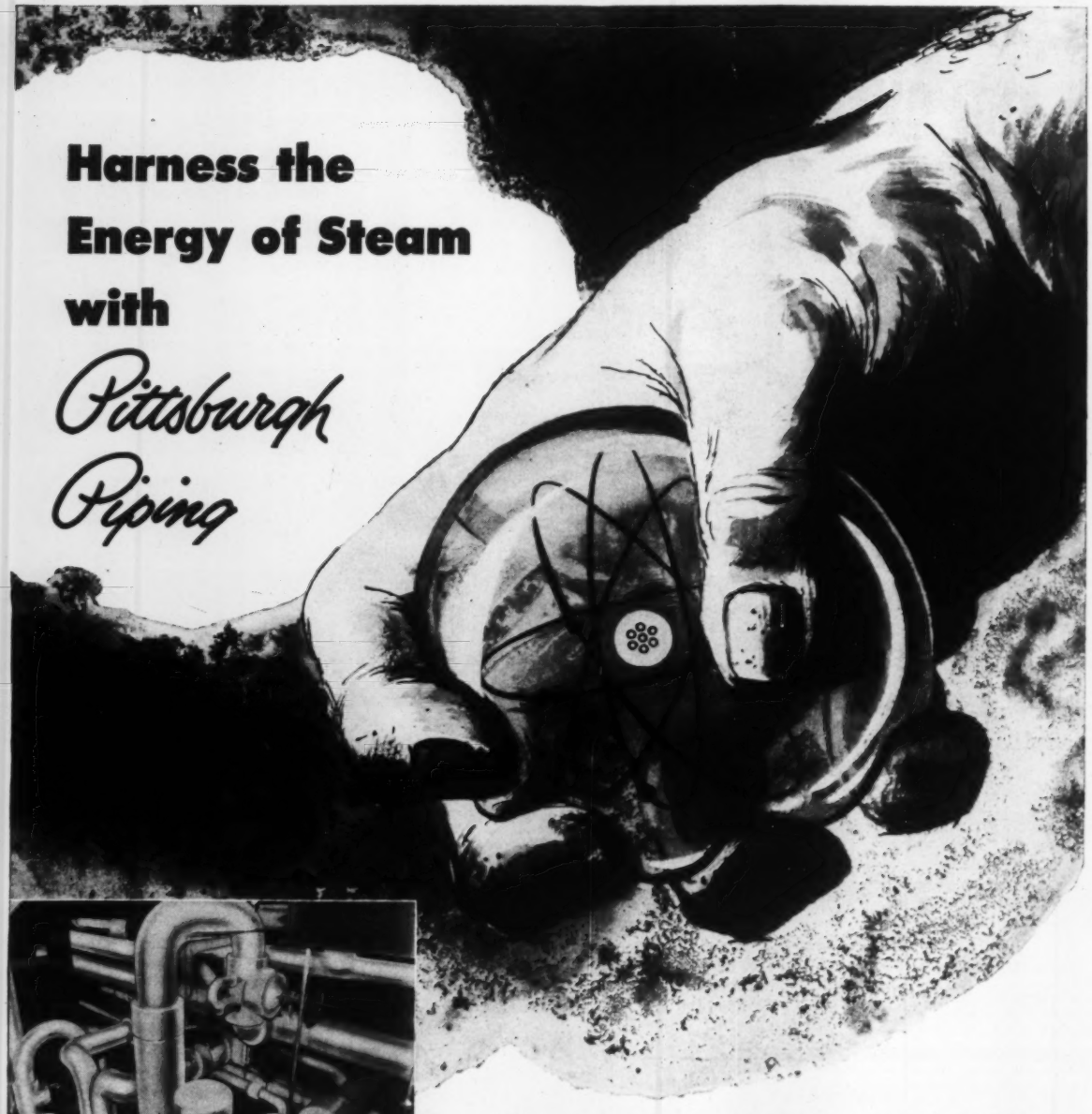
If your operations involve multiple pumps with variations in service requirements, look into this basic BJ Type U Seal. If your pumping needs are more highly specialized in any one field, there's a BJ Mechanical Seal engineered to solve almost every stuffingbox requirement.

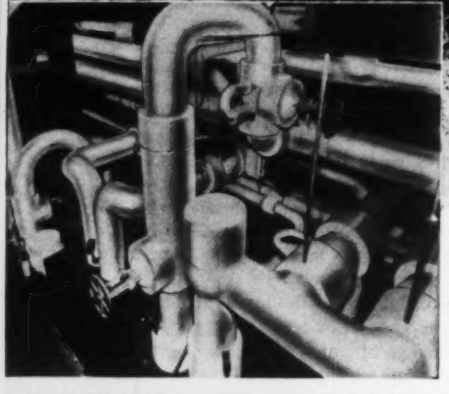
FREE MECHANICAL SEAL SELECTION PORTFOLIO—Send for this special Byron Jackson Mechanical Seal Selection Portfolio. Includes size, material, price and installation information. Write today to:

Byron Jackson Pumps
INC.
A Subsidiary of Borg-Warner Corporation
P.O. Box 2017A, Terminal Annex
Los Angeles 54, California

BJ

Harness the Energy of Steam with *Pittsburgh Piping*





Pittsburgh Piping installation of high pressure boiler feed piping in central station.

Are you interested in piping to harness the flow of superheated steam, gas or liquid, or to control the corrosive action of process materials?

Call upon Pittsburgh Piping for this type of piping . . . for the electric generating station, nuclear power installation, chemical processing plant, refinery, mill, or factory.

We are specialists with complete facilities, and we assume responsibility for every phase of a piping job — from blueprint through erection.

Pittsburgh Piping

AND EQUIPMENT COMPANY

158 49th Street — Pittsburgh, Penna.

CANADA: CANADIAN PITTSBURGH PIPING, LTD.
835 BEACH ROAD—HAMILTON, ONTARIO

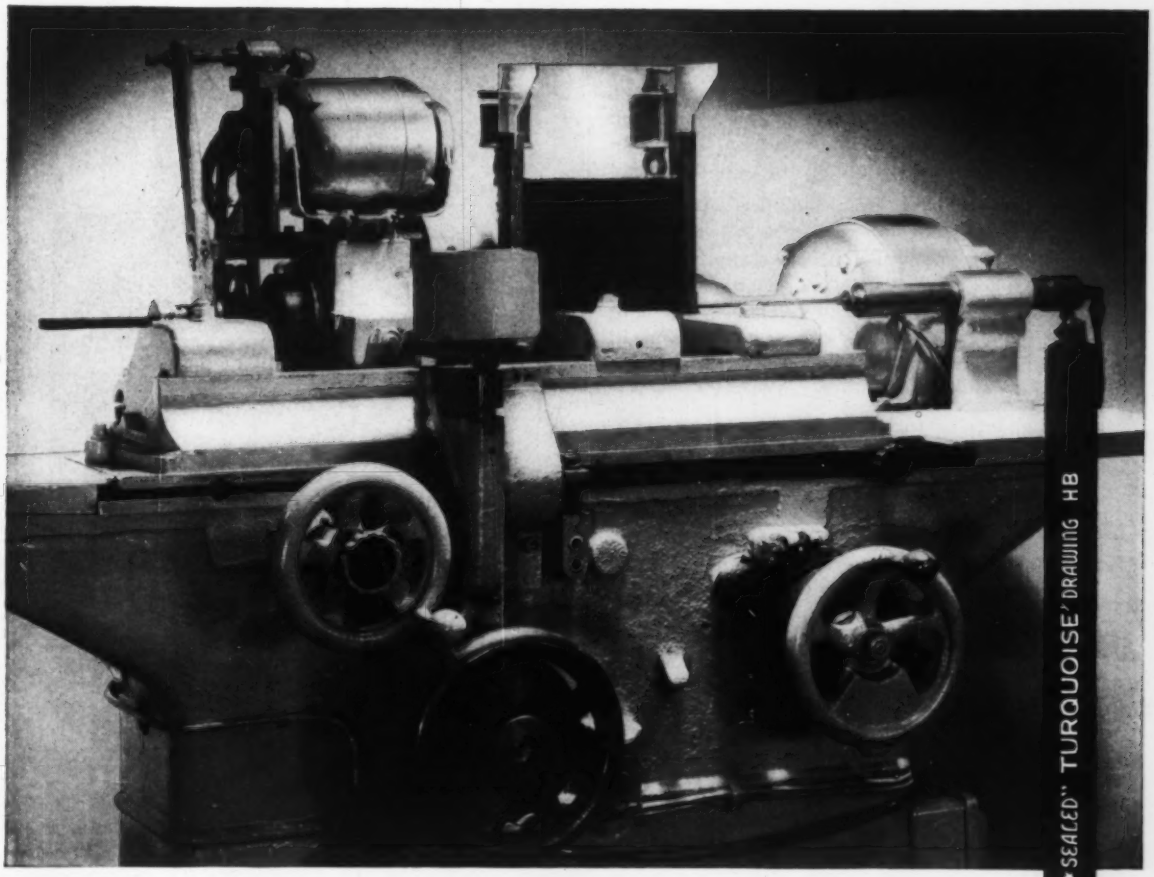
PP-25

PRODUCTS AND SERVICES

Carbon Steel Piping	Forged Piping Materials
Cast Iron Fittings	Headers
Cast Steel Fittings	Manifolds
Chrome-Moly Piping	Pipe Bends
Copper Piping	Stainless Steel Piping
Corrugated Piping	Van Stoning
Creased Bends	Welded Assemblies
Expansion Bends	Welded Stainless Steel Tubing
Flanges	Welding Fittings

OFFICES IN PRINCIPAL CITIES

Atlanta	Whitehead Building
Boston	10 High Street
Chicago	Peoples Gas Building
Cleveland	Public Square Building
Hollywood	1828 North Alexandria Ave.
New Orleans	P. O. Box 74
New York	Woolworth Building
Syracuse	113 So. Salina Street
Toronto	68 Yonge Street



TWO-TON TILLIE

sharpens pencils to one ten-thousandth of an inch!

To perfect this gentle giant, Eagle laboratory technicians spent three years and $25,000—because Two-Ton Tillie makes our other pencil tests make sense.

It sharpens *all* test leads, thick or thin, hard or soft, Eagle or competitive, down to a cylindrical point of .050″ diameter (± .0001″) as illustrated at right. You can see that such a "point" will present a constant area to the paper throughout any test and will let us compare smoothness, durability or opacity on a fair and equal basis.

It will also sharpen at any desired angle, creating identical long-tapered drafting points for needle-point strength tests.

The results enable us to test our research, confirm our improvements and maintain our quality. Whether *you* sharpen your pencil by knife, razor, sandpaper block, or regular pencil sharpener, remember Two-Ton Tillie. It's part of Eagle's continuing research to *keep* TURQUOISE the finest drawing pencil in the world.

SAMPLE OFFER: *Send for a free Turquoise Drawing Pencil in the grade you prefer, 6B to 9H. Prove it's best in your own hand. (Please mention this magazine.)*

HEADQUARTERS FOR QUALITY PENCILS
100 EAGLE PENCIL COMPANY YEARS
1856 - 1956

TURQUOISE®

DRAWING PENCILS AND LEADS

EAGLE PENCIL COMPANY New York 9, N. Y.·London·Toronto·Mexico City·Sydney

● A new dual-beam cathode-ray oscillograph with facilities for precise observation, comparison and measurement of two related a-c or d-c signals.

Has two complete vertical amplifiers with response flat to d-c and uniform within 30% to 300 kc. Amplitude measuring on both channels includes 16 ranges from 400 volts full scale to only 4 millivolts for full deflection to scale limits. The most sensitive range permits a-c or d-c measurements in the microvolt region. Balanced input is available on the seven most sensitive ranges.

High-level, accurate, calibrated, linear sweeps; automatic beam gate; sweeps range from 1 sec./inch to 2 usec./inch in 19 steps common to both channels.

X-amplifier provides up to 20 inches of undistorted sweep expansion; external horizontal input to either or both channels.

Observe, compare and measure two related AC or DC signals with the new, high precision

PRICE
$990.00

DU MONT TYPE 333
CATHODE-RAY OSCILLOGRAPH

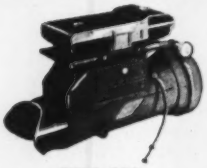
AND FOR THE RECORD...

TYPE 296

Versatile, economical 35 mm general-purpose oscillograph record camera with f/2.8 lens. Price $149.50

TYPE 299

General-purpose recording camera accepts variety of backs for 120 size roll film, cut film or film pack; inexpensively converted into print-a-minute Polaroid Land camera. Price $265.00



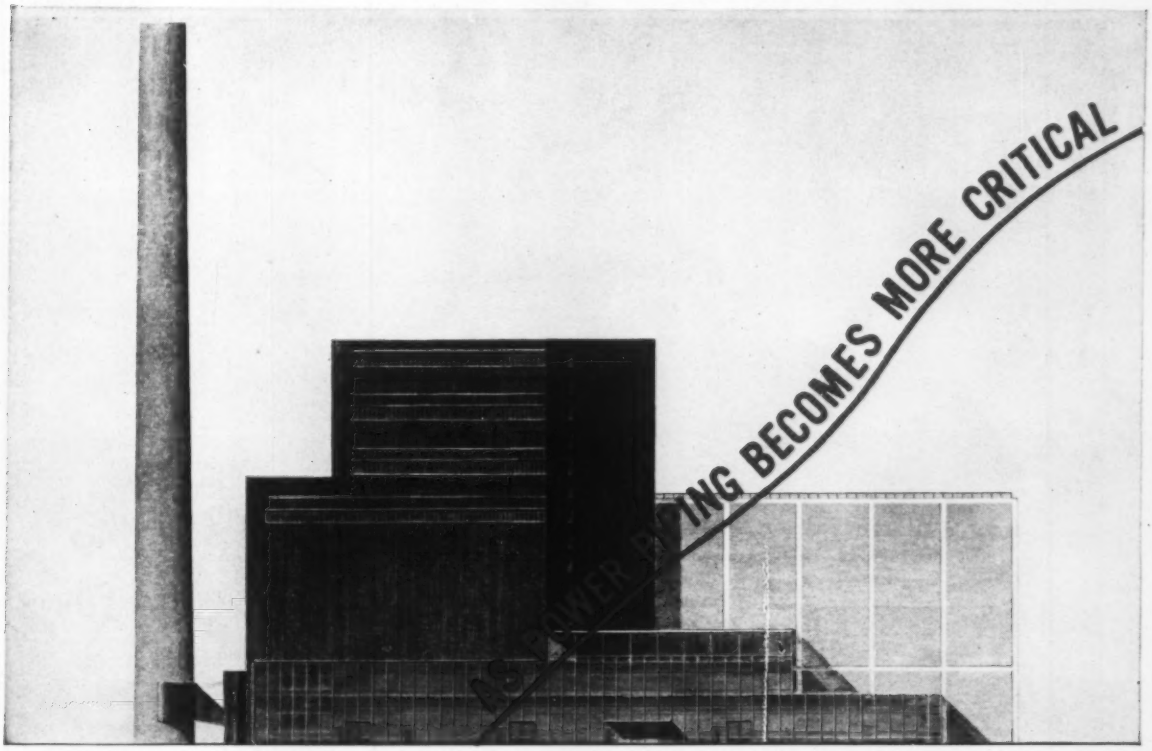
TYPE 302

For permanent records in just a minute with Polaroid-Land back; by simple, inexpensive change of backs can be adapted for general-purpose recording with other than Polaroid films. Price $285.00

TYPE 321-A

Continuous motion or single-frame recording on 35 mm perforated or unperforated film or recording paper; film speeds variable in steps from 0.8 to 3600 inches/minute. Price $1050.00

DU MONT TECHNICAL PRODUCTS DIVISION
Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J.



Architect's sketch of Philadelphia Electric Company's new Eddystone station

Kellogg's High Alloy Fabrication Keeps Pace

Designed to operate at 5000 psi at turbine throttle valve, and 1200 F., Unit No. 1 at Philadelphia Electric Company's new Eddystone station presented critical problems in the selection of an alloy for supercritical pressure piping, and in techniques for fabricating heavy-walled sections of this alloy in the shop and in the field.

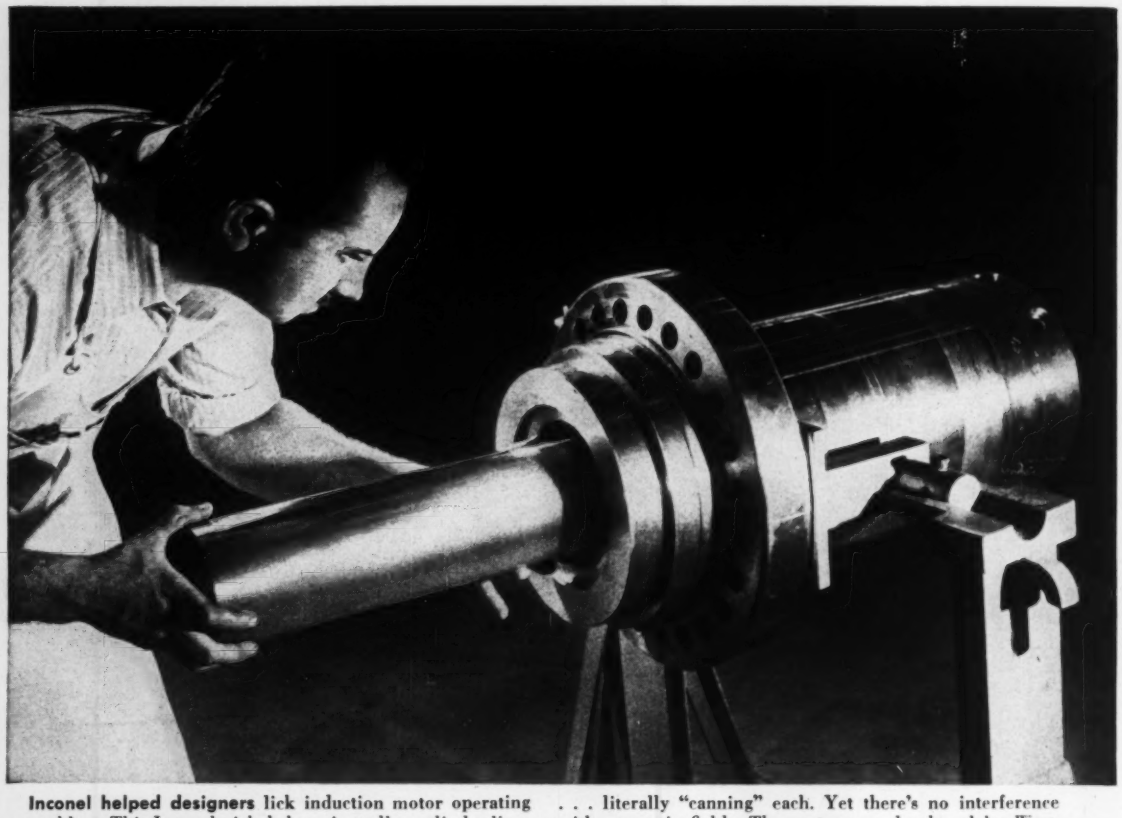
More than a year ago, The M. W. Kellogg Company presented a comprehensive program to the Philadelphia Electric Company for selecting a suitable alloy, and since then has been working closely with this public utility and other prime contractors toward completion of the project. Numerous materials were studied, welded, tested, heat treated, and evaluated at Kellogg's Jersey City metallurgical laboratories. After many months of extensive and intensive work, Type 316 Stainless was selected. M. W. Kellogg has already perfected welding techniques, and is now continuing tests on this alloy and several other compositions, including strain aging for 1000 hours and 10,000 hours at 1300 F., to accumulate other data.

While this is the first time that Type 316 will have been used in power plant service for temperatures as high as 1200 F., and pressures as much as 5000 psi, it is by no means Kellogg's first experience with Type 316 or other stainless steels. For example, M. W. Kellogg recently undertook metallurgical studies and research for another large public utility prior to its selection of Type 316 for use at 1100 F. and 2400 psi. Kellogg also has done considerable fabrication of main steam lines and turbine leads, using Type 347.

The M. W. Kellogg Company welcomes the opportunity of discussing future power piping requirements with consulting engineers, engineers of power generating companies, and manufacturers of boilers, turbines, and allied equipment.

FABRICATED PRODUCTS DIVISION
THE M. W. KELLOGG COMPANY, 711 THIRD AVENUE, NEW YORK 17, N. Y.
A SUBSIDIARY OF PULLMAN INCORPORATED
The Canadian Kellogg Company Ltd., Toronto • Kellogg International Corp., London • Kellogg Pan American Corp., New York • Societe Kellogg, Paris • Companhia Kellogg Brasileira, Rio de Janeiro • Compania Kellogg de Venezuela, Caracas

POWER PIPING—THE VITAL LINK



Inconel helped designers lick induction motor operating problem. This Inconel nickel-chromium alloy cylinder lines the bore of the stator, and another surrounds the rotor core . . . literally "canning" each. Yet there's no interference with magnetic fields. The motor was developed by Westinghouse Electric Corporation for the U. S. Government.

Inconel an essential in the "canned" pump

. . . resists corrosion and heat

A number of Atomic Energy Commission projects now employ hermetically sealed pumps. They circulate reactor coolants in high-temperature, high-pressure closed systems.

This type of pump contains all moving parts in a pressure-tight cell. It houses the impeller driven by an induction motor, together with stator and rotor in separately sealed "cans."

It is well named a "canned" motor-pump. And, with two metallic walls between stator and rotor, it depends fundamentally on Inconel* nickel-chromium alloy for successful operation.

Inconel an essential

As shown above, a thin liner of Inconel alloy is inserted in the stator to seal it from the coolants pumped. A similar liner protects the rotor.

The designers, Westinghouse Electric Corporation, selected Inconel nickel-chromium alloy because it meets four important demands:

1. **It resists corrosion by aggressive high-purity water**
2. **It resists corrosion by certain liquid metals**
3. **It has the necessary non-magnetic properties**
4. **It has high electrical resistivity**

Other advantages

Inconel alloy is structurally stable. It is not subject to embrittlement on prolonged heating in non-sulfidizing atmospheres.

Inconel alloy is chemically stable. It resists damage by oxidation, carburization and other forms of high-temperature attack.

Inconel alloy is mechanically stable. It retains useful properties to 2100°F. and over, in some applications. It resists grain growth and withstands thermal shock.

Inconel alloy is easy-to-work . . . easy to form, machine, weld . . . available in all commercial wrought forms.

Learn how Inconel nickel-chromium alloy may help you. *Send for Inco's 24-page Technical Bulletin T-7.* It gives data on properties, available forms, and how to fabricate. It's yours for the asking. And if you have a specific high-temperature problem, call on Inco's Technical Service Section . . . giving full details when you write.

*Registered trademark

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

INCO TRADE MARK **Nickel Alloys**

Inconel . . . *for long life at high temperatures*

Volume 78 • Number 10
OCTOBER 1956
•
Published by
The American Society of Mechanical Engineers

Officers of the ASME

J. W. Barker, *President*
J. L. Kopf, *Treasurer*
C. E. Davies, *Secretary*
E. J. Kates, *Assistant Treasurer*

Editorial Department

George A. Stetson, *Editor Emeritus*
J. J. Jaklitsch, Jr., *Acting Editor*
E. S. Newman, *News Editor*
J. Foster Petree, *European Correspondent*
L. S. Blodgett, *Consulting Editor*

Advertising Department

S. A. Tucker, *Publications Business Mgr.*
M. H. Marty, *Business Manager*
N. M. Loseff, *Asst. Business Manager*

Publications Committee

Otto de Lorenzi, *Chairman*
W. E. Reaser
Kerr Atkinson
John de S. Coutinho
B. G. A. Skrotzki
R. A. Cederberg } *Junior Advisory*
H. N. Weinberg } *Members*

Regional Advisory Board

Roy L. Parsell—Region I
A. D. Blake—Region II
C. C. Franck—Region III
Francis C. Smith—Region IV
H. M. Cather—Region V
C. R. Earle—Region VI
M. B. Hogan—Region VII
Linn Helander—Region VIII

Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Dynamic," New York. Price to members annually $3.50, single copy 50 cents, to nonmembers annually $7.00, single copy 75 cents. Add $1.50 for postage to all countries outside the United States, Canada, and the Pan-American Union. Changes of address must be received at Society headquarters seven weeks before they are to be effective on the mailing list. Please send old as well as new address... By-Laws: The Society shall not be responsible for statements or opinions advanced in papers or ... printed in its publications (B13, Par. 4).... Entered as second-class matter at the Post Office at Easton, Pa., under the Act of March 3, 1879.... Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921.... © Copyrighted, 1956, by The American Society of Mechanical Engineers. Member of the Audit Bureau of Circulation. Reprints from this publication may be made on condition that full credit be given MECHANICAL ENGINEERING and the author and that date of publication be stated.

MECHANICAL ENGINEERING is indexed by the Engineering Index, Inc.

MECHANICAL ENGINEERING

European Design Trends—
in Mechanical Materials Handling . . . . . *H. W. von der Recke* 906
Psychological Tests in an Engineering Department . . . . . *J. M. Parish* 912
The Solar Furnace—
New Tool for High-Temperature Work . . . . . *Guy Benveniste and N. K. Hiester* 915
Burning Fluid Coke . . *Ollison Craig and E. H. Smith* 921
Human Engineering—
A New Approach to Operational Design . . . . . *G. A. Peters, Jr.* 926
Test Facilities—
Aeronautical Turbine Laboratory . . . *L. G. Tilton* 927
Industry Under Enemy Attack . . *B. W. Bruckmann* 932

Editorial 905
Briefing the Record 937

Oceanographic Research, 937; Air-Cooled V-4 Engine, 938; Rolling Classroom, 939; Coke-Processing Plant, 940; Liquid Chemical Lock Nut, 941; Cartridge-Actuated Devices, 942; Plastic-Coated Steel Sheet, 943; Leaded Steel, 943; Stroboradiography, 944; Small Submarine Reactor Prototype, 945; Nuclear Briefs, 945; Modified Chromium Steel, 947; Steel Jetties, 947; Photo Briefs, 948

European Survey 950

Hydroelectric Power in Europe, 950; Power From the Danube River, 950; Universal Milling Machine, 951

ASME Technical Digest 952

Applied Mechanics, 952; Hydraulics, 957; Power, 959; Metals Processing, 961; Instruments and Regulators, 963; Management, 964; Availability List of Unpublished ASME Papers, 964; ASME Transactions (*Journal of Applied Mechanics*) for September, 1956, 965

Comments on Papers 966
Books Received in Library 968
ASME Boiler and Pressure Vessel Code 969
ASME News 971

ASME Annual Meeting Program, 971; Educational Funds Report, 978; Junior Forum, 978; ASME Manpower Shortage Questionnaire, 979; ASME Power Show, 981; ASME Student Conferences, 982; Mechanical Catalog, 985; ASME Coming Events, 985; ASME Codes and Standards Workshop, 985; Personnel Service, 986; Candidates, 988; Obituaries, 988

Roundup 990

EJC Engineering Graduates Survey, 990; AEC Research Reports, 991; NCSBEE Meeting Report, 991; Meetings of Other Societies, 992; Coming Meetings, 992; People, 993; Education, 994; Industrial Films, 996; Research, 996

Keep Informed 41
Classified Advertisements . 165
Consultants 188
Advertisers 190

Automation aide's skilled human fingers . . .

. . . wire small, circular core units that serve as "nerve" cells for a new switch that is expected to stimulate assembly-line automation. Called a "magnetic detective" by its developers, electronic engineers at Minneapolis-Honeywell's Doelcam Division, the new switch, monitoring an assembly-line sequence of parts containing metal, "confirms" each piece as it comes along and trips a remotely located relay so the part can move on to the next station—conversely, it shuts down the whole assembly line if there is a break in the parade of pieces the switch is checking off. The laminated iron cores replace bulky amplifiers in the magnetic circuitry of the new switch. First application will be on Ford's 1958 engine-block manufacturing lines.

Volume 78 • Number 10

OCTOBER 1956

•

George A. Stetson, *Editor Emeritus*
J. J. Jaklitsch, Jr., *Acting Editor*

MECHANICAL ENGINEERING

K. W. Clendinning

On August 16, while the text pages of the September issue were going on the press, Miss K. W. Clendinning, managing editor of this magazine, suffered a cerebral hemorrhage and died a few hours later. She had served The American Society of Mechanical Engineers for forty years and was the heart and soul of its editorial department.

Month after month from the time edited copy was sent to the printer and until the magazine was mailed, she was the department's principal contact with the printer and the authors of papers. She supervised the proofreading, sized the cuts, made up and checked the pages, approved the bills, and kept a keen eye on the budget and her staff. During the existence of the *ASME News* as an independent semimonthly periodical she performed the same duties for it. When Transactions ASME was changed from an annual to a periodical publication in 1927 she took on responsibility for its production. Nor was this all. Sandwiched between these regular assignments were numerous special publications, such as preprints and reprints of papers presented at meetings, reports, and pamphlets of a variety of forms and sizes. Thus she learned that the reward for good work is more work.

Under Miss Clendinning's administration the editorial department existed as a benevolent matriarchate. She demanded a full measure of performance from each member of her staff. Although she jestingly referred to herself as a slave driver, the response from those who worked under her was based on a sincere admiration of her abilities and energy and affection for her as a friend and fellow worker. She shared their worries and troubles with an understanding that inspired confidence. Although her words of comfort or advice could lighten the heavier burdens and her common sense dissipate the trivial ones, the strain of giving to others so much of herself was emotionally more exhausting to her than they realized. A sensitive person herself, she recognized and respected sensitivity in others; but for self pity she had no sympathy.

One never doubted where Miss Clendinning stood on any question. She was positive and forthright in her views and a worthy opponent in argument. A warm impulsiveness prompted her instinctive judgments. But she was too intelligent and too honest not to change her opinions once she found them to be wrong. Rarely did a saving sense of humor forsake her, particularly when she found that she had been a victim of her own impetuous nature. Her wit and native intelligence were well suited to banter and ready repartee. She sized up people quickly and shrewdly. She despised pretense and overbearing demeanor. Her sympathies were with the underdog and the humble in spirit. She responded to frank, warmhearted, and courteous treatment. In her dealings with authors she was polite but firm. Many of them got to know her well if only through correspondence. Strong ties of mutual admiration and respect existed between her and many distinguished members of the Society who sought her out, valued her opinions, and enjoyed her conversation. Her common sense saved many of her colleagues from foolish acts and rash decisions. When conditions warranted it she could deflate the ego of her fellow workers and authors and force them to take a critical look at themselves. Such encounters usually ended in friendship and understanding. One might say that she applied high standards and corrective techniques to people as well as to printer's proof.

It was characteristic of Miss Clendinning's outlook on life to consider the demands and responsibilities of her job as having priority over those of her private life. When most persons would seek justifiable escape from the daily routine, she appeared to find in her work an effective specific for physical ailments and personal problems. Not to appear at the office no matter how physically ill or tired she might be was cause for humiliation which she could not bear. On those rare occasions when she could not be present, she would telephone instructions or carry on the work at home. One learned that no amount of pleading or command to slow down or rest was effective. At best one could only sense and try to understand the driving force of her will power and rely upon the extraordinary recuperative qualities of her body and spirit to work their miracles. Courage and fortitude overcame the frailties and physical handicaps of her not too robust body.

Dedication to work and professional pride in it insured the high quality of the technical periodicals which Miss Clendinning administered. She would spare no pains to check the queries of proofreaders and the vague or undecipherable notations of authors. This meticulous zeal for accuracy involved extensive correspondence with authors and submission of several proofs until every detail was as perfect as possible. But her practical nature made her equally insistent on meeting deadlines and mailing dates.

There is something relentlessly permanent about the printed word. Once off the press it remains to reflect credit or discredit on everyone associated with it. Miss Clendinning's high standards and tireless efforts are reflected in the accuracy of ASME periodical publications. What this accuracy means to those who use the publications, engineers particularly can appreciate. Authors and the Society are forever in her debt for her devoted services in safeguarding their reputations. "Let her own works praise her."—G.A.S.

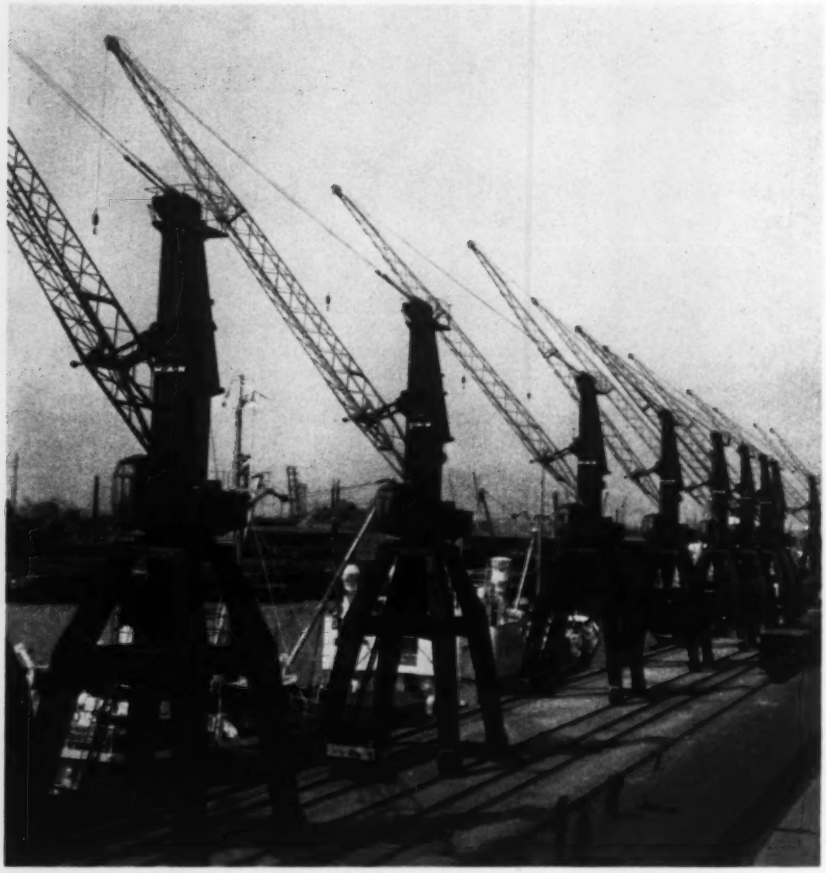


Fig. 1 This battery of new type dockside cranes are of box-and-shell construction

European Design Trends—

in Mechanical Materials Handling

By Hans W. von der Recke

Sales Engineer, Hewitt-Robins, Inc., New York, N. Y.

In recent years remarkable progress has been made in the mechanical handling of materials. While much is known of new materials-handling devices built in the United States, little has been published here on recent developments in Europe.

Political and economic circumstances have greatly influenced the work of European engineers. Shortage of raw materials and the necessity to accomplish much with limited means, in many instances, have been the governing factors for new designs. The result has been savings in material and operating cost, as well as greater flexibility of a device. Such trends are evident in:

New crane types which revolutionize conventional standards.

Belt conveyers which can be built to almost unlimited length and at the same time use light and inexpensive rubber belting.

Conveyers which can handle material on the forward as well as on the return strand.

Belt conveyers which carry material at inclines of up to 65 deg, and conveyers which can carry bulk material around vertical and horizontal curves.

Contributed by the Materials Handling Division and presented at the Semi-Annual Meeting, Cleveland, Ohio, June 17–21, 1956, of The American Society of Mechanical Engineers. Condensed from ASME Paper No. 56—SA-22.

Dock Cranes

Crane types which have been developed during the past few years in Europe represent something entirely novel in the field of dock-side cranes. A notable box-and-shell construction has brought about this decisive change in crane design, and has created a completely different style, Fig. 1. Three advantages are expected from this new design; i.e., savings in weight and in material, longer life, and a dynamic appearance.

Especially, the last point should not be underestimated. Recent developments show that the appearance of a device is important especially when it is installed at an exposed spot.

Most dock-side cranes have a four-leg box-constructed base. The legs are filled with cement to act as a counterweight. This is a very apparent advantage over the old-fashioned crane which supported the counterweight on its turntable.

Another decisive difference between the cranes of old design and the cranes of new construction is the mounting of the slewable section, Fig. 2. The base of the old crane carried a ring rail on which the slewable crane section—centered by a king journal—moved on rollers. This arrangement, of course, put limitations on the ring diameter and demanded a minimum weight of the slewable section.

The new design is free from these disadvantages because it has the slewable part supported by a hollow center post, Fig. 3. It is easy to see that a great saving in weight, and consequently in ultimate price, is generated by eliminating the turntable.

The advantages of a center post become even more obvious when the post of some cranes can be used for entering the control cabin. The elimination of the exterior platform, ladder, and railing contribute considerably to the saving in material, weight, and maintenance.

Most cranes are equipped with all technical improvements of modern crane design: such as, driver's cabin with infrared heating, electroacoustic communication systems, load indicator, load-limiting device, and sensitive controls for all working speeds.

The superiority of the new crane construction will become more evident since it is proved that a saving in material, as high as 50 per cent, is achieved as compared with cranes of older design. This important saving has not been bought with disadvantages but has resulted in great new technical gains.

Belt Conveyers

The rubber belt of a belt conveyer serves a dual purpose: (1) It has to carry the load, and (2) it has to transmit horsepower from the driving pulley to move the load. The ability of the belt to carry the load remains unchanged, regardless of the length over which the load has to be transported, or the height to which it must be lifted. However, the horsepower for driving a conveyer increases with its length and lift. An increase in horsepower demands a proportionately stronger, and consequently more expensive, rubber belt. In many instances, the cost of the belt is as high as the cost of all the mechanical components of a belt conveyer. In addition, replacement of the belt which is subject to much wear is ordinarily necessary at regular intervals.

Hence, it has been attempted to reduce the initial cost of a heavy conveyer belt by replacing it by a lightly

Fig. 2 Slewable part of dockside crane of unique design

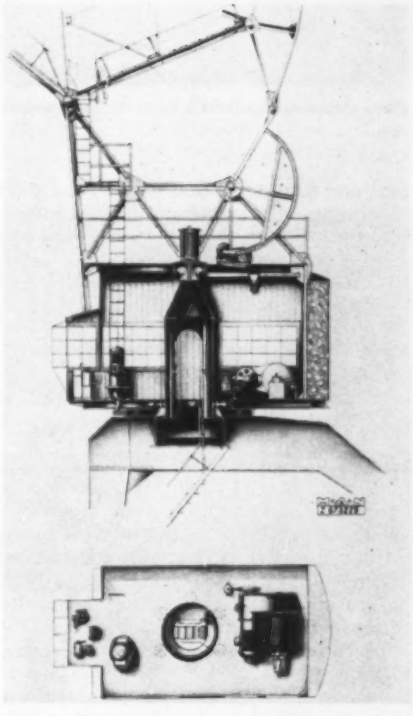


Fig. 3 Center post supports slewable part of new crane

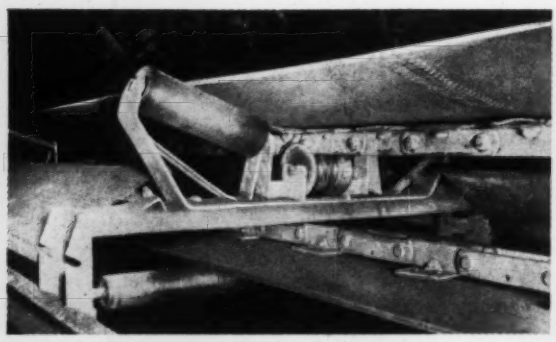


Fig. 4 Steelbar-type chain shown propelling conveyer belt

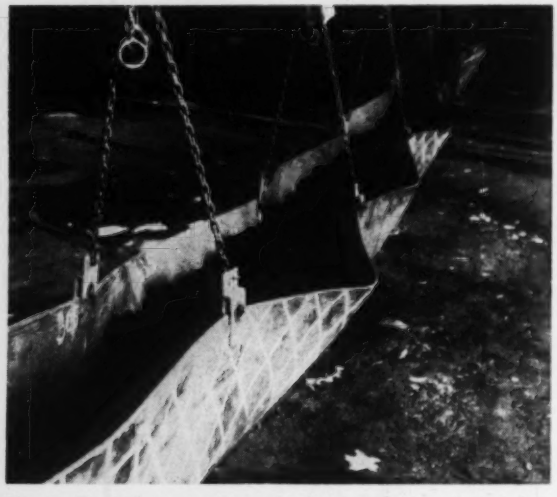


Fig. 5 Deep dents are formed where chains are fastened to belt

constructed one whose function is restricted to carrying the material only. The work of providing the forward motion and transmitting the horsepower is performed by an inexpensive chain or a wire rope.

The advantages which can be expected from such a belt-conveyer design are:

Relatively low initial purchase cost.

Less danger of fire arising from the rubber belt because there is no belt slip at the pulleys.

Conveyers can be made of almost unlimited length.

Power requirements are estimated to be up to 50 per cent less.

Steelbar-Type Chain Propulsion. When a steelbar-type chain propels the conveyer belt, every second or third link of the chain is provided with a rubber-covered bearing plate, which supports the top belt in the upper section of the conveyer, and carries the belt with the material lying on it. In the lower section of the conveyer the bearing plates rest on the bottom belt, and carry it along in the opposite direction, Fig. 4.

Conveyers can be made in almost any length if intermediate drives are inserted. It is important that the belt will consist of only one continuous strand over the total length of the conveyer. However, one separate chain must be used for each intermediate drive section.

Fig. 6 Tilted idlers discharge material from conveyer belt

Rubber-Covered Steel-Wire-Rope Conveyer. With the same basic idea in mind to separate the tension-carrying from the material-carrying element, a flexible rubber-covered wire rope of high tensile strength has been used in another design in place of the foregoing steel chain.

However, the conveyer belt must be of special construction for this application. This belt is made of only a few plies of cotton duck, and is strengthened at the edges and in the specially designed middle section by diagonal layers of reinforcing material. The middle section includes a groove over the total length of the bottom side of the belt into which the power-transmitting wire rope is inserted. Near the head end of the conveyer, special two-pulley idlers open the groove and separate the rope from the belt. The rope is then free to be guided over the driving sheave.

In order to limit the thickness of the wire rope for long conveyers, it can be subdivided into several flights, and intermediate drives can be inserted.

Unsolved Problems. Several problems still remain to be solved by the inventor. The complete lack of tension will cause belts wider than 24 in. to sag between idlers. There is no doubt that the belt design will have to be improved. Ribs will have to be added while the middle of the belt and the cable will serve as backbone.

A comparison with American practice shows that American engineers too have solved the problem most successfully of moving heavy loads farther and higher. This has been accomplished by a new Super Raynile conveyer belting designed and manufactured by the author's company. In contrast to the European method, no change of the standard machinery components for belt conveyers is necessary; and yet the Super Raynile belt is lighter in weight than duck and rubber belting of equal strength, and more resilient than steel-reinforced belting.

Suspended Conveying Belts

The separation of the carrying from the power-transmitting medium upon which the design of the previously described conveyers is based, also has been employed in another invention. A conveyer type was

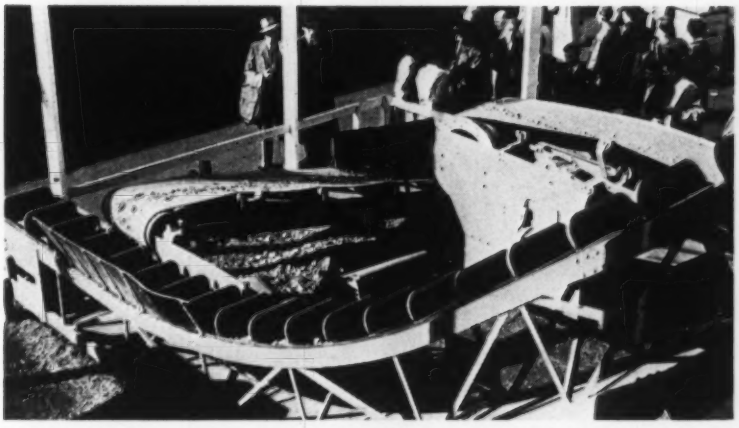


Fig. 7 Elevating conveyer belt equipped with cleats made from used rubber belts

developed by "crossbreeding" a belt conveyer with a ski-lift, and has been named "Schwebeband" which could be translated "gliding belt."

The device distinguishes itself from the well-known ski-lift design by replacing the seats which carry the skier uphill with a troughed conveyer belt. This belt is suspended from chains which are fastened at the belt edges and hang from a steel buckle which in turn is clipped to the rope. The ropeway is spanned between conveyer supports.

The belt does not have to transmit any driving power. The wire rope alone carries and moves the belt along.

Deep dents are formed at those points where the chains are fastened to the belt, and subdivide the belt into cells into which the material is squeezed tightly, Fig. 5. A backsliding or rolling of the material on inclined conveyers is thus prevented. Angles up to 30 deg have created no difficulties.

The greatest advantage of a gliding belt is the low price of the belting. A saving of at least 50 per cent over a standard conveyer belt has been estimated for long installations. However, it must not be forgotten that this saving is absorbed to a certain degree by the additional requirement of a wire rope which will have to be replaced several times during the life of the belt.

In order to achieve a synchronized stretch of the wire rope and the belt, the latter is led over a take-up pulley which turns loosely and independently from the rope-drive wheel.

In order to unfold the belt before bringing it around the terminal pulley, the belt is guided between two side rollers, and then carried and lifted by flat idlers which are installed in succession, and in increasingly tilted positions. This arrangement provides at the same time a simple and easy way of discharging the material from the belt, Fig. 6.

The gliding belt will have an estimated 50 per cent higher capacity than a standard troughed-belt conveyer, as the result of a considerably larger cross-sectional area.

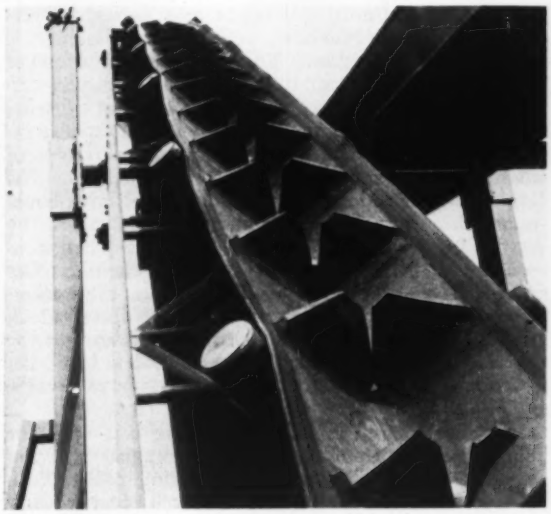


Fig. 8 Cleat sections form solid wall when belt is led over troughing idlers

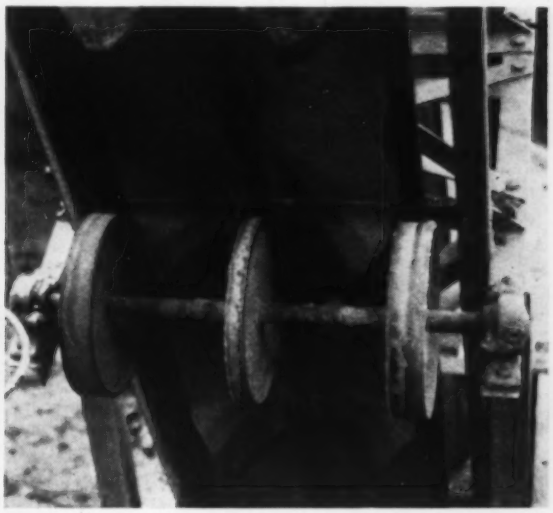


Fig. 9 Special disk idlers support return strand of elevating conveyer

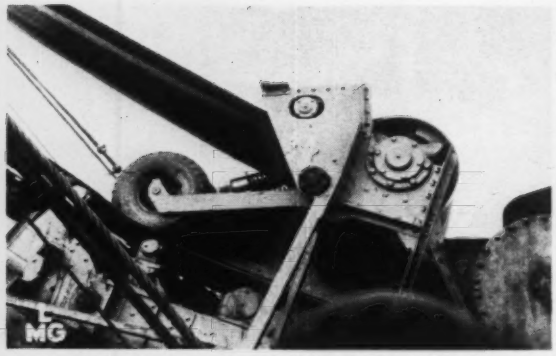


Fig. 10 Point of contact between hugger belt and carrying belt

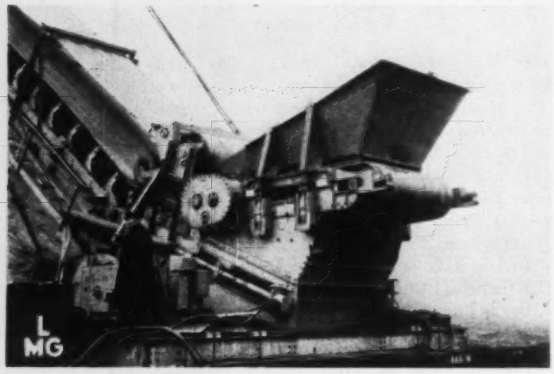


Fig. 11 Loading hopper which feeds elevating conveyer

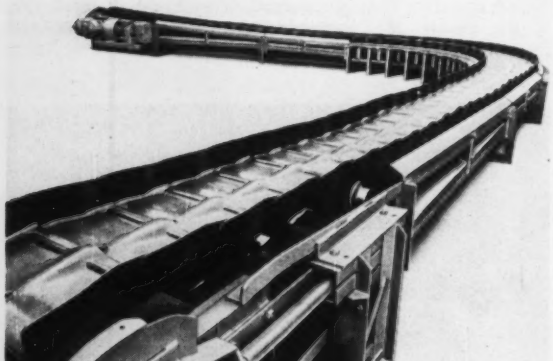


Fig. 12 Curve-going steel-apron conveyer used for coal mining

Elevating Conveyers

The potential range of sizes, speeds, and capacities of belt conveyers is so great that these factors seldom determine whether a belt conveyer will serve the purpose. Of all the main physical characteristics of the plant requiring a belt-conveyer system, the most important is the relation between the horizontal distance the material has to be transported, and the vertical distance it has to be lifted. These two factors determine the angle of inclination of the conveyer. If this angle of inclination is so great that the material will roll back on the belt, it may be necessary to combine a conveyer with some other mechanical, and usually expensive, means for lifting the material. To avoid this additional equipment, it often has been the practice to equip a conveyer belt with cleats which prevent the material from rolling back at steep inclines. When the material consists of large lumps these cleats can only be effective when they are of a certain height. High cleats, however, will create new design problems.

Cleated Belts. An interesting type of "elevating belt conveyer" equipped with cleats was exhibited at the Mining Fair at Essen, Germany, in 1954, Fig. 7. The cleats made of pieces of used rubber belts are inserted into slots in the conveyer belt. Fixed idlers are eliminated, and are replaced by rollers attached to the belt below the cleats.

The rollers can guide the belt in steel channels around horizontal and vertical curves. Material is usually discharged over the head end.

The conveyer also can be used in a declined position at transfer points in place of chutes which would be too shallow to give the material the desired flow. The capacity is estimated at 150–200 tons per hr at a belt width of about 18 in.

Troughed-Belt Design. While the conveyer thus described is based on a flat belt, another unit is of troughed-belt design, Fig. 8. This conveyer is capable of elevating material with lumps up to 6 in. in size at an angle as steep as 65 deg, and operates at a belt speed of 200 to 300 fpm. Here again, cleats prevent the material from rolling back. Two cleat sections are fastened to the belt parallel to but independent from each other. These sections close up to a solid wall when the belt is led over two-pulley troughing idlers supporting the carrying strand. For the return strand special return-disk idlers are required, Fig. 9. The belts are manufactured in widths ranging from 16 to 36 in. Although several installations are already in operation, the experience gathered until now is not great enough to permit passing judgment as to the success of this design.

Bucket-Wheel Dredgers. The West German open-cut lignite mines with their considerable hauling performance and great quantity of overburden offer an occasion unique in the world to develop very special and large-scale instruments. The machines used for this type of mining are, in general, bucket-wheel dredgers. The digging element of a dredger is the wheel with buckets attached thereto. The material is discharged by gravity from the buckets onto an inclined belt conveyer, and then carried to railroad cars, or the like. Until now, it was common practice to work the bucket-wheel dredger at a maximum depth of about 17 ft, because ordinary conveyer belts could not transport the material at inclines steeper than 18 or 20 deg. In order to work greater depths it became necessary to develop an "elevating conveyer."

The novel design includes a carrying belt with the hugger belt lying on top of it. The hugger belt protects the climbing material from rolling back. Both belts are driven at a synchronized speed independently from each other, each by its own drive. The hugger belt is pressed down on the carrying belt and on the

Fig. 13 Return strand of curved-apron conveyer can run parallel with carrying strand and can be used for moving materials into the mine

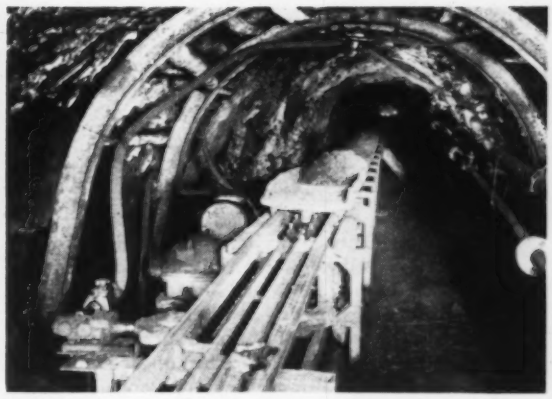


Fig. 14 Apron-conveyer train can run over switches to different roads. Coal can be hauled from the mine and tools can be carried into the mine.

material by spring-actuated rolls which consist of automobile tires. It is possible with this arrangement to negotiate angles up to 40 deg.

The transition of the hugger belt to the carrying belt can be well recognized in Fig. 10. The loading point is illustrated in Fig. 11. This photograph also shows the top idlers above the hugger belt which are necessary to prevent it from being raised by strong winds.

Naturally this type of elevating conveyer also can be used for various stationary applications.

Curve-Going Conveyers

The introduction of belt and apron conveyers to the European coal-mining industry during the first quarter of this century has brought advantages greater than any other type of mechanization. However, only the mining of horizontal seams could profit from these conveyers while pitching seams had to be neglected. The demand to pay more attention to pitching seams has become greater and greater in Germany and France during the postwar period. Consequently, it became mandatory to invent a conveyer which would be able to follow the course of such a seam. This conveyer had to have the ability to go around curves and had to be built of almost unlimited length in order to avoid transfer points. Thus the problem was clearly defined.

Nevertheless, a relatively long time was needed to find satisfactory solutions. These were finally based on the standard well-known apron-conveyer design, Fig. 12.

The curve-going conveyer consists of a number of "linked" aprons which make it possible to go around certain horizontal curves on account of their connection to each other. The minimum half-radius has been determined at 20 ft. Extraordinary conveyer lengths can be achieved if intermediate drives are added.

The linked apron strand is of great flexibility which enables the return strand to be led along the wall. An additional twist of the belt makes it even possible to carry material on the return strand, Fig. 13. Experience and knowledge gained with this conveyer have brought about the thoughts of a one-strand conveyer running in a circle.

The discharge of the material is then accomplished by a twist of the belt around an angle of 60 deg. Any material can be carried from the mine as well as into the mine.

Although characterized by their great flexibility, these two types of conveyers have been used exclusively for the mining of horizontal seams. While they have the ability to fulfill the technical demands of the mining of pitching seams, their large capacity makes them uneconomical for these seams with their low output.

Conveyers for Pitching Seams in Coal Mining. Nevertheless, it has been possible to develop from these conveyers a type which is ideal to cope with the conditions existing at pitching seams. A belt section with a minimum length of the distance between two intermediate drives can move steadily on an empty truss like a train, Fig. 14.

This apron-conveyer train can run over switches to different roads. Coal can be hauled from the mine and tools carried into the mine.

The use of any number of trains 22 or 30 in. wide permits tailoring the conveyer system to any required capacity. The drives are fully automatic and are turned on or off by the trains themselves. The hopper gates are also automatically opened or closed for loading by the conveyer train. The switches are remote controlled. The truss consists of standardized sections which are easily erected or dismantled, and can be used over again when the conveyer has to be moved to other roads.

Although the considerable quantity of 22 miles of this type of conveyer has been furnished to the mining industry, the construction should be considered to be still in its infancy. It is reasonable to expect that the design will be improved. Other markets might be discovered outside of the mining industry. No doubt there will be many materials-handling problems which can only be solved by the apron-train conveyer.

The Moving Sidewalk. In the United States a similar principle of linking aprons to each other in order to make them negotiate horizontal curves has been applied for the design of a new moving sidewalk, developed by the author's company.

Although not all of the inventions described in the foregoing are applicable for the conditions existing in this country, an exchange of ideas may be provoked which can only lead to progress, and we may be stimulated by the thoughts of our European colleagues.

Psychological Tests in an Engineering Department

By J. M. Parish, Member ASME

Chief Engineer, Louisiana Division
The Dow Chemical Company

Psychological tests prepared by qualified professional psychologists are reliable and deserve high rank in an employee-selection program. On-the-job performance is improved when the supervisor has available, and understands, the test results of each individual he supervises. All supervisors should receive competent instructions in the use of such test results. These tests alone are insufficient basis for selection and assignment of personnel, but, used in proper combination with other factors, they yield gratifying results.

Management cannot hammer people into shapes to fit its jobs. It must accept them pretty much as they are. The only alternative is to try to select the right people from those available and to place them in jobs they like, can do well, and from which they can advance to be of increasing value to the company.

Test History in Engineering Department

In this division of our company we have for several years employed psychological tests to help us in our selection of employees. In the Engineering Department, the results have been gratifying. Before the adoption of tests, we felt that the chances of our choosing the right employee for a given job in the department were about even—half of the time the choice would be highly satisfactory, half of the time it would not. Today, we consider our chances to be better than three-to-one. The tests have also helped measurably in reducing the turnover rate. In the past three years under the program, only eight people have left this department (of 160 employees) for work in other companies.

We are convinced that the use of psychological tests in our department has been a significant factor in reducing our replacement costs, helping us to hire employees of higher caliber, and in improving the quality of our product-engineering work. Our experience is not unique. Whereas 25 years ago psychological tests in industry were rare, it is estimated that more than 60 per cent of industrial concerns now use psychological tests.

We must, however, avoid the error of concluding from these facts that tests offer a final answer to all selection problems in industry. They do not, and it is not expected that they ever will. Over-enthusiastic selling and acceptance of testing have done it a great disservice and have caused a reaction to set in, resulting in the situation that many executives now underrate testing.

Contributed by the Petroleum Division and presented at the Petroleum-Mechanical Engineering Conference, Dallas, Texas, Sept. 23–26, 1956, of The American Society of Mechanical Engineers. ASME Paper No. 56—PET-3.

It is both our company and department policy to give special attention to the development of balanced practices in the hiring process. We recognize that tests are not a panacea, but that their intelligent use, integrated with other good procedures, will do a lot to improve any selection program. More specifically, we recognize that tests only implement; they do not supplant the interview or the weighted application form.

Above all, we recognize that tests cannot and must not replace the right and the responsibility for management to decide whom it will hire. Tests must not be a scapegoat, an instrument for avoiding the responsibility of hiring. We decide whom we will hire and accept the consequences. Tests are merely an important tool in helping us to make the selection.

Selecting the Right Test

A company desiring to institute a psychological testing program is confronted with a nearly limitless variety from which it may choose. Hundreds of psychological firms publish thousands of tests. Which one should be selected? Some companies have installed programs simply by buying tests and giving them. Occasionally the programs have been good, but usually they are failures.

Test Objectives

The right program differs among companies and perhaps even among the component departments of the companies, depending upon the qualities considered to be most important in the given tasks. A good testing program is one which gets results. A test is good if, through its use, the company is able to pick more "right" men and eliminate more "wrong" ones for the jobs available.

We are unable to outline a program which will necessarily be of value to all companies or departments, nor necessarily to any other company or department—the problems to be solved may differ in each case. We can simply outline the essentials of our program, which we believe has been of immense benefit to us.

In general, if an organization decides that it is desirable to set up a testing program, and determines what are the chief problems it intends to solve, it will want to try out a number of likely tests to see which will prove most useful. Test consultants, after reviewing the particular needs of the organization, can best suggest the test to be considered. After investigation the Louisiana Division, accepting recommendations of a firm of industrial-psychology consultants, chose testing procedures which seem well suited to our needs, and the program adopted became standard for all departments.

Applicants are tested by Personnel Department staff. Completed tests are sent outside the company to psychometricians for scoring. Results are interpreted by psychologists, who then make recommendations regarding selection and placement. This information is returned

to the Personnel Department, through which it becomes available to the departments which might be interested in the services of the applicant.

Tests Used in Engineering Department

We make use of two intelligence tests: One is the Otis Quick-Scoring Mental Ability Test; the other is the Wonderlic Personnel Test.

Applicants for our engineering jobs take the Otis, while most of the other applicants for employment in the Engineering Department (principally clerical and administrative workers—about one fifth of the department's personnel) are given the Wonderlic tests. This is a 50-question 12-minute test; the Otis is 30 minutes in length and covers 80 questions. Of the personality tests available we use the Humm-Wadsworth Temperament Scale. The Humm-Wadsworth Scale is of very special value to us in engineering. We are particularly anxious to learn which of our people are most apt to be individual workers, and which are likely to have supervisory abilities. It is becoming increasingly apparent as experience is gained in pure research, as well as in applied company programs, that the area of personality is the most important one in supervisory roles.

Technical skills are relatively easy to measure. Personality factors are far more vital to the success of a supervisor. For him, the ability to handle human relations is the most important of all qualifications. Our tests help us to predict who will best show such ability.

It is also very important to decide who would make the best project engineers and who would make the best design engineers. The Humm-Wadsworth Scale is a valuable tool in helping us to predict this.

Still another value in this scale is the indications it gives of the amount of detailed supervision likely to be most effective in individual cases, and, to some extent, the type of supervision—forthright or subtle.

The familiar Kuder Preference Test is given to help determine where an employee's or an applicant's interests lie.

Of our nontechnical personnel, applicants for stenographic jobs take a shorthand test and a typing test, on each of which there are minimum scores which must be achieved.

A clerical aptitudes test, designed by Science Research Associates, is given. It consists of three parts: office vocabulary, office arithmetic, and office checking.

In addition to these tests the Science Research Language Skills Test, consisting of four phases, is given: word meaning, spelling, punctuation, and word division.

These nontechnical tests give us a high degree of performance predictability and are not unduly long or difficult to administer. Skills are relatively easy to measure and skills tests are therefore high in validity. Thus, they enable us to have a very good idea of how well an applicant for one of our clerical jobs will perform if hired.

To be successful, a testing program must be understood and endorsed by many people within a department or company. Supervisors and department heads must be sold on the program. Ours are—they understand its value to them. We are careful not to violate their rights to a voice in selection and in recommending promotion.

Training of Supervisors

Understanding the program does not require knowledge of psychology to the extent studied by the professional psychologist. But it is desirable—a necessity, in fact—that our supervisors of every level understand sound fundamentals of human relations and motivation. To this end there is held in our Engineering Department, on the average once yearly, an on-the-job series of lectures by one or another of our consulting psychologists. The attendance of all supervisors is expected, unless, of course, they have attended a previous series. Over the years these series of lectures have ranged from a total of 9 hr up to a total of 16 hr, depending upon the particular lecturer's preference. It is not feasible to outline here the content of these lecture courses. But these few highlights will probably convey an idea of the instruction given.

Conceptual "Points of Departure"

1 Objectives of the individual employees and those of the department can be mutually realized through proper courses of action.

2 Ability to produce, or effective know-how, is the major determining factor of success of the individual.

3 Performance is effective only when people have the will to put their potentialities to work.

4 Progress is attained when people have the desire to become better—to improve their services, methods, costs, knowledge, and all other areas of import. Innovation and creativity are essential.

5 Building a more effective organization of workers is a process—it must always be a matter of "becoming."

Principles Related to Behavior

1 As an Individual. Each is different due to his unique combination of natural mental aptitudes and temperamental qualities, in conjunction with his developed habits, attitudes, skills, and knowledge. As a result, each person: (*a*) Has his relative degree of speed and ease in learning and a specific capacity regarding the complexity of things he can comprehend; (*b*) is mentally and temperamentally more adaptable to particular types of work than to others; (*c*) may have his own unique way of doing things and yet can be as effective as others in performance and accomplishments; (*d*) understands and reacts to other people in his own unique manner; (*e*) has his relative degree of strain which he can withstand without handicapping effects and his unique way of reacting to dissatisfaction; and (*f*) enjoys being understood and managed as an individual.

2 *As a Human Being.* Each employee has certain natural inclinations which may be designated as basic desires: (*a*) To do something wherein his actions are purposeful and meaningful; (*b*) to identify himself with something or with people he considers important and worth while; (*c*) to gain companionship, acceptance, and recognition from others; (*d*) to have adequate freedom of choice in actions; (*e*) to have opportunity for self-betterment or improvement; and (*f*) to have adequate security protection for himself and for those with whom he is closely identified.

3 *As a Citizen of an Industrial Society.* The environment has considerable influence upon his motivations and values. The "climate" which impinges upon the worker in his industrial society thus strongly influences the demands he makes upon his work. The major aspects of these influences are constituted in demands for: (*a*) Advancement and "getting ahead"; (*b*) making

more money and attaining a higher standard of living; (*c*) equality in opportunity and justice in evaluation of job achievement; and (*d*) stable employment, or job security.

4 As a Member of an Organized, Purposeful, and Controlled Group. Man, by nature, is gregarious or group-minded, as well as individualistic. Most of his basic needs and satisfaction desires can be realized only through participation in group actions. In order to initiate and develop desirable identification and accomplishment within the structure of the group, the following conditions are primary: (*a*) Group objectives must be dynamic and challenging to stimulate the members to effective action; (*b*) when the remote objectives represent a never-ending process, sub-goals or immediate objectives must be established; (*c*) objectives must be conceived as attainable; (*d*) the accomplishments of the group are relative to its utilization of the potential of its members; (*e*) the achievement of the group should be greater than the sum total of achievement potential within the individual membership; (*f*) in any group there is always a significant or dominant person for position of leadership; (*g*) each member must understand, accept, and be willing to contribute toward attainment of the objectives of the group; (*h*) each member must gain adequate acceptance within the group; and (*i*) each member must receive adequate satisfaction from his contributions and associations.

Basic Practices

Selection of People. Selection of people is a multiphased practice which, in the initial stage, places increased emphasis upon the caliber of those charged with the responsibility for selection. The technical employment manager with responsibility for screening applicants and the line managers charged with final-selection responsibility should be thoroughly trained to gain insight into the general and specific qualifications essential in any applicant. Such training includes a functional understanding of: (*a*) Established standards for qualification in specific jobs; (*b*) a specialized knowledge and skill in effective practices of interviewing; and (*c*) a working knowledge of the administration and application of reliable and valid methods of objective measurement to fortify and supplement interview information.

The foregoing outline of the training that is given to supervisors through the psychologist's lectures is necessarily incapable of touching all phases of the subject. The case method, for example, is used extensively in discussions (with actual identities concealed, of course). Supervisors seem to be unanimous in placing high value on the practical knowledge gained from these lectures.

Our employees below the supervisory level are also well acquainted with the department's use of psychological testing (incidentally, all of our employees, including the chief engineer, take the test; there is no feeling of discrimination in the application of our program). Each employee is permitted, though not compelled, to review his test results with one of the consultants of the Psychological Service Institute. He receives counsel as to how he can improve and can work to achieve his potentialities.

Interpreting Test Results

Psychological tests are used to measure the degree of certain human qualities present in a person and are employed by the department as an implement to substantiate or invalidate other indications predicated upon observation, previous performance, or other frames of reference.

In our department we are convinced that psychological tests have paid us handsome dividends. We believe that, properly instituted and operated by qualified personnel, they will likewise benefit most companies and most large departments.

But testing should be thought of as only a part of the selection program. It is a grievous mistake to select solely or even primarily on the basis of test scores. Tests should not supplant other methods of selection, but should be used to implement them and, in fact, to encourage the consideration of other factors. Management must retain its prerogative to employ whom it chooses. It must not make psychological tests either its instrument or its scapegoat. It must retain the responsibility for hiring and, equally important, it must accept the consequences of its choices.

It should be emphasized that all practices utilized in original selection of people are directed toward gaining an understanding of the applicant, and are not solely for the purpose of collecting information about him.

Psychological tests used by the department are designed to measure the qualities of intelligence, aptitudes, skills, interests, and temperamental make-up of people. These instruments have been carefully constructed, validated, and standardized, in order to assure reasonably valid, reliable, and comparable results. Due to the nature of human qualities and tests as tools of measurement, there is always an element of error in measurement, and the results are most properly interpreted when considered in terms of ranges or relative degrees.

We evaluate in ranges that encompass five categories expressing a degree of capacity or competence depending upon the factor being measured. In the event of predictive factors, the measurement is regarded as a capacity. In measuring demonstrated performance, the factor is regarded as a competence. These evaluative categories are established to correlate with the normal probability statistical curve in the areas of capacity, but are necessarily skewed in the evaluation of competence as evidenced through performance. Considering the evaluative procedures utilized in original selection of people, the engineering department has established standards or criteria in four primary areas—general intelligence, special aptitude and skill, interests, and temperament.

Selection of Testing Personnel

Perhaps the most critical matter of all concerns the personnel operating the program. Tests are no better than the personnel interpreting them. Fully qualified psychologists with PhD degrees are rare—it has been

(*Continued on page 947*)

The Solar Furnace . . .

. . . New Tool for High-Temperature Work

Basic Principles—Characteristics of Furnaces in Operation—Large U. S. Units Planned—Historical Background

By Guy Benveniste[1] and Nevin K. Hiester

Stanford Research Institute, Menlo Park, Calif.

CERTAIN properties of sunlight and the fact that concentration of it permits the attainment of high temperatures must have been known for a long time. The Chaldeans used a convex quartz lens to read tablets bearing fine inscriptions that could not be read with the naked eye. In the comedy, "The Clouds," by Aristophanes, Stepsiades explains to Socrates how he intends to defeat his creditors by aiming a burning glass properly as he meets them, so as to melt the wax tablets on which the debt is recorded. Pliny and others also described small glasses which were used to light fires or even "to corrode away the dead flesh of those patients who stand in need of caustics (1)."[2]

The most famous account of the successful concentration of sunlight is attributed to Archimedes who, in 212 B.C., while attempting to help defend Syracuse from the invading ships of Marcellus, is reputed to have "set fire to Marcellus' navy by means of a burning glass composed of small square mirrors moving every way upon hinges, which when placed in the sun's ray, directed them upon the Roman fleet, so as to reduce it to ashes at the distance of a bow shot" (1).

Inspired by this achievement, Anthermius of Tralles, the architect who built Saint Sophia in Constantinople in the 6th century A.D., calculated that with 24 hexagonal mirrors reflecting sunlight on one spot it would be possible to obtain the necessary conflagration (1). Others repeated these experiments and Proclus is reputed to have burned the fleet of Vitellius with a similar arrangement during the siege of Constantinople.

After the fall of the Roman Empire and the advent of the Middle Ages, scientific curiosity found few channels of expression. New experiments with lenses and reflectors were dropped and achievements forgotten. Indeed with the passage of time the mirrors of Archimedes became somewhat legendary, even to the point that Descartes writing in the 1630's felt obliged to note that these mirrors were probably a fable (2). It was not until the end of the 17th century that renewed interest in lenses and reflectors brought these so-called legends to the attention of researchers.

In 1695 Averoni and Targioni of Florence used a large burning glass to decompose a diamond previously considered unalterable; Tschirnhauss in Germany, Parker in England, and later on Geoffroy and Homberg in France found the lens or solar furnace an invaluable tool in their studies of the properties of matter and fire. In their work they used lenses of 33 in. diam made especially for these purposes. With these they melted many metals and substances that until then had resisted the heat of the strongest fires (3, 4).

De Buffon in 1747, impressed by these furnaces and doubting the opinion of Descartes on this matter, demonstrated that with a properly arranged array of 168 mirrors he could burn wood at 200 ft, melt lead at 130 ft and silver at 60 ft (5, 6). With de Buffon's experiments and those of his colleagues, the solar furnace became a high-temperature tool of the new science of chemistry.

The first perfected furnace of this era is attributed to Lavoisier, the French chemist, who in 1774 built a large double-lens furnace to demonstrate that diamond was just another form of carbon (7). His larger lens of 52 in. diam was made of two curved sheets of glass filled in between with alcohol. Lavoisier was nearly able to melt platinum, and must therefore have obtained a temperature close to 1750 C.

The present era of modern furnaces probably starts in 1909 with the work of Stock and Heyneman who built a two-lens adjustable-mounting unit. Since then the furnaces built by the Zeiss company at Jena in 1921 (8), at the California Institute of Technology in 1932 (9), at Mont Louis in the French Pyrenees in 1946 (10), at Bouzareah (11) near Algiers, and at many other places, have established these furnaces as one of the practical sources of intense heat for use in research and industrial processes.

Basic Principles

Outside the atmosphere, the sun's intensity yields approximately 1.35 kw per square meter. This figure, called the solar constant, varies by about ±3.5 per cent because of the elliptic nature of the earth's orbit and ±1.5 per cent because of solar disturbances such as sun spots, and so on. Not all this energy reaches the surface of the earth. Some is scattered or absorbed by gas and air molecules and by particles in the atmosphere. The amount of energy available at noon on a clear day on a surface perpendicular to the sun's rays varies with the season, the altitude, the latitude, and the clearness of the sky at the site. However, in many parts of the United States this figure, as a rough approximation, may be assumed to vary between 0.8 kw per square meter to 1.1 kw per square meter.

[1] Assoc. Mem. ASME.

[2] Numbers in parentheses refer to the Bibliography at the end of the paper.

Contributed by the Power Division and presented at the Fall Meeting, Denver, Colo., Sept. 10–12, 1956, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Paper No. 56—F-7.

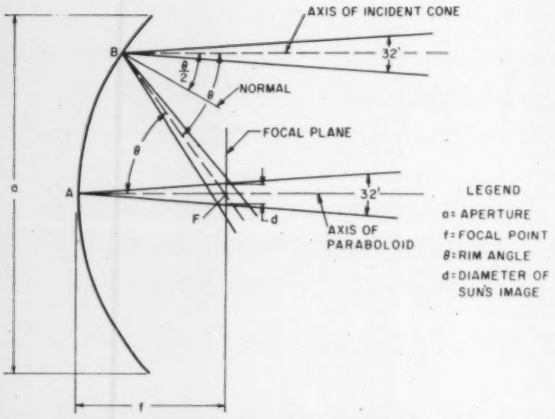


Fig. 1 Schematic diagram showing parabolic mirror with incident cone of rays being reflected to focal plane

The amount of energy per unit area e_0 available at the site of the furnace at any moment is therefore

$$e_0 = S\eta_a \quad [1]$$

where e_0 is given in kilowatts per square meter or watts per square centimeter; S is the solar constant; η_a is the efficiency of transmission of direct solar radiation through the atmosphere of the earth.

Concentration Ratio

While lenses have been used in the past, their cost has made their use nearly prohibitive in modern solar-furnace construction. Actually only the furnace at the California Institute of Technology is a lense furnace and this simply because it was built with materials available at the end of the construction of the Mount Wilson Observatory. All other high-temperature furnaces are paraboloids and we shall discuss here the basic principles applicable to the geometry of these units.

With a parabolic reflector it is possible to concentrate the heat flux available at the site of the furnace so as to obtain in practice a flux sufficient to maintain temperatures above 3000 C. The concentration ratio and the concentration efficiency of a furnace are important parameters that permit evaluation of the heat flux and temperatures available on the target at the focus of the paraboloid.

The sun is not a point source of light. Its apparent diameter, as seen from the surface of the earth, is about 32 min of arc. This means that the sun's rays are not quite parallel and for each point on a parabolic mirror the incident and therefore the reflected beams are not single beams as in the case of parallel rays but cones with an apex angle of 32 min.

Fig. 1 shows a typical parabolic mirror. It can be seen that only the central beam forms a circular image of the sun at the focus of the paraboloid. All the other reflected cones form ellipses that are more or less pronounced according to the angle of incidence of the beam on the target.

The diameter d of the circular image of the sun depends only on the focal length of the paraboloid and is given by

$$d = 2f \tan 16' = \frac{f}{107.3} \quad [2]$$

where f is the focal length of the paraboloid.

This characteristic of solar furnaces limits the ultimate concentration ratio that may be obtained. As the ratio of the aperture to focal length of the furnace is increased, more and more solar energy is concentrated on the target from points on the mirror that subtend large rim angles and cause very pronounced ellipses around the solar image. As the rim angle θ approaches 90 deg, less and less additional energy is concentrated on the solar image. When the rim angle θ reaches 90 deg, no additional components of energy can reach a flat target.

The total amount of energy E that reaches the circular image of the sun is given by

$$E = \pi\eta_{ar} S f^2 \sin^2\theta \quad [3]$$

where η_{ar} = efficiency factor defined in Equation [4].

S = solar constant
f = focal length
θ = rim angle of furnace

The efficiency factor η_{ar} is

$$\eta_{ar} = \eta_a\eta_r \quad [4]$$

where
η_a = efficiency of transmission of direct solar radiation through earth's atmosphere
η_r = efficiency of reflection of sunlight on various surfaces of furnace

We can therefore write Equation [3] as

$$E = \pi\eta_r e_0 f^2 \sin^2\theta \quad [5]$$

where e_0 is the amount of energy per unit area available at the site of the furnace as defined previously.

The heat flux per unit area within the sun's image is a more useful concept and, since the sun's image area is given by

$$\pi(f/214.6)^2$$

the heat flux per unit area within the sun's image is given by

$$e = \eta_r e_0 (214.6)^2 \sin^2\theta \quad [6]$$

$$e = 46.1 \times 10^3 \eta_r e_0 \sin^2\theta \quad [7]$$

The concentration ratio C_r is the ratio by which the energy which is available at the site of the furnace is concentrated on the sun's image at the focus of the paraboloid

$$C_r = \frac{e}{e_0} = 46.1 \times 10^3 \eta_r \sin^2\theta \quad [8]$$

The theoretical concentration ratio C is the concentration ratio independent of the efficiency of reflectivity η_r

$$C = 46.1 \times 10^3 \sin^2\theta \quad [9]$$

Another interesting concept is the percentage of energy incident on the surface of the furnace that is theoretically concentrated on the area of the sun's image. This percentage η_e, the theoretical concentration efficiency, is independent of the efficiency of reflectivity η_r

$$\eta_e = \left(\frac{1 + \cos\theta}{2}\right)^2 \quad [10]$$

These concepts permit us to examine the performance of paraboloids with varying rim angles. Fig. 2 shows that as the rim angle of the furnace is increased the theoretical concentration ratio also increases, reaching a maximum of 46,100 for a flat target and for a rim angle of 90 deg. It is significant that the theoretical concentration efficiency decreases as the rim angle increases; in other words, it gets more difficult to place energy in the area of the sun's image. A furnace with a rim angle of 30 deg is theoretically capable of concentrating 87 per cent of the energy incident on the furnace on the sun's image while a furnace with a rim angle of 70 deg only concentrates 45 per cent of the energy incident on the sun's image.

Actual Furnace Efficiency

In addition to the theoretical concentration efficiency η_c, we have considered the efficiency of transmission through the atmosphere η_a, and the efficiency of reflectivity of the surfaces of the furnace η_r. We also may consider the imperfections of a mirror or furnace as an efficiency factor η_f and the efficiency of absorption of light by the target as η_t.

The total efficiency η with which the solar constant is concentrated and absorbed by the target is therefore

$$\eta = \eta_c \eta_r \eta_f \eta_t \eta_a \quad \ldots\ldots\ldots\ldots\ldots\ldots [11]$$

and the flux available to heat the target e_t is

$$e_t = 46.1 \times 10^3 \eta S \sin^2 \theta \quad \ldots\ldots\ldots\ldots [12]$$

Temperature

When a target is placed at the focus of a paraboloid, it will reach an equilibrium temperature which depends on the flux e_t and on the conduction, convection, and reradiation heat losses of the target. At high temperatures, conduction and convection losses are less important than radiation losses. A black body at certain temperatures radiates (a function of the fourth power of the temperature) the heat fluxes shown in Table 1.

Table 1 Black-Body Radiation

Temperature, deg K	Heat flux, watts/cm²
1500	29
2000	91
2500	223
3000	462
3500	857
4000	1456
4500	2338
5000	3568
5500	5216
6000	7392

It should be possible, in theory, to obtain with a theoretical maximum-concentration ratio of 46,100 and with, let us say, 1 kw/m² at the site of the furnace a heat flux e_t of about 4610 watts per sq cm. With this flux an equilibrium temperature above 5000 K could be expected. In practice the losses caused by reflectivity η_r, the imperfections of the furnace η_f and the efficiency of absorption of energy by the target η_t result in lower operating temperatures of the order of 3500 K. In addition, all of the furnaces built to date have rim angles less than 90 deg and theoretical concentration ratios lower than 46,100.

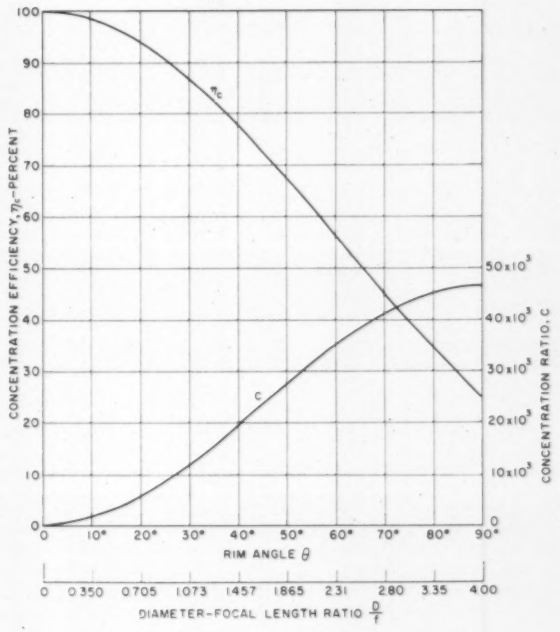


Fig. 2 Concentration ratio and concentration efficiency as a function of rim angle and diameter focal length ratio for a parabolic solar furnace

In this respect it is important to stress the fact that none of the furnaces built to date has reached temperatures above 3500 C. This temperature corresponds to an equilibrium heat flux of about 1000 watts per sq cm, if conduction and convection losses are disregarded. At these temperatures these losses may still amount to one third of all losses and the equilibrium heat flux may therefore be closer to 1400 watts per sq cm. We see in Table 2 that most modern furnaces are designed to yield higher flux densities, in some cases even reaching above 3000 watts per sq cm. But in practice geometrical imperfections and reflectivity of the target keep the actual maximum heat flux absorbed by the target closer to 1400 watts per sq cm.

Physical Arrangements

To use a solar furnace effectively, attention must be given to many details such as physical mountings, sun tracking mechanisms, target holders, control mechanisms, auxiliary laboratories, and so on.

Tracking the Sun. Arrangement must be provided to follow the sun during the day and during the seasons. With a single parabolic surface it is possible to have the paraboloid rotate on a single support while the focus moves in space above the mirror. It is also possible to have a stationary focus in space and a mirror so supported that it may be moved easily to maintain the focus stationary. Usually in large units auxiliary mirrors are used to facilitate access to a stationary focus (Figs. 3, 4, and 5). Auxiliary mirrors in this case are usually simpler to operate and actually less expensive than the delicate and sturdy mechanisms that must be provided to rotate accurately the entire paraboloid and focus.

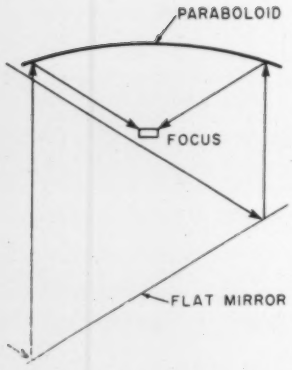


Fig. 3 Heliostat mounting

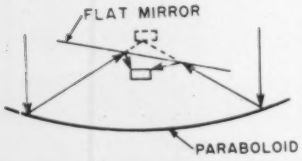


Fig. 4 Newtonian mounting

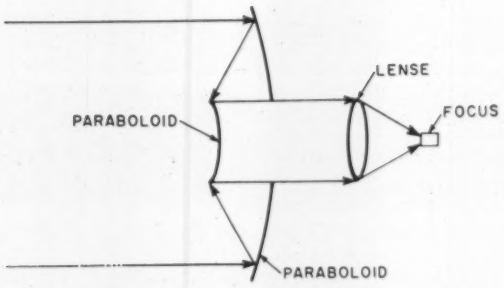


Fig. 5 Lens arrangement in Cassagranian mounting

Table 2 Characteristics of Modern Solar Furnaces

		Mont Louis	Algiers	Convair	Cal. Tech.
1	Number of reflectors or lenses in series	2	1	1	3
2	Aperture, ft	35.0	27.6	10.0	..
3	Focal length, ft	19.7	10.3	2.83	..
4	Ratio of aperture/focal length	1.78	2.68	3.53	..
5	Effective concentrating surface, sq ft	936	566	75.5	57.0
6	Theoretical diameter of image, in.	2.2	1.15	0.32	0.5
7	Theoretical concentration ratio	26000	40000	45000	20000
8	Assumed surface reflectivity efficiency (η_r), per cent	70	80	80	60
9	Assumed atmosphere transmission efficiency (η_a), per cent	74	74	74	74
10	Assumed geometrical imperfection efficiency (η_f), per cent	100	100	100	100
11	Available flux density at image, watts/sq cm (under conditions assumed)	1820	3200	3600	1200

Heating the Target. A substance to be melted can be placed in the focus of the furnace and can be supported outside the focus. For certain experiments this simple setup is adequate. In some instances it is preferable to have the substance move slowly so that the molten product is removed from the zone of high temperature and fresh unmelted material brought in. When, for example, zirconium oxide is melted, the thermal conductivity of the molten surface is low and reduces the speed of the operation unless the substance is displaced and a new nonmelted surface exposed. This operation is performed with a carriage on small wheels, if powders are used, or with any other suitable arrangement, depending on the characteristics of the substance to be treated.

Another technique consists of feeding a powder by gravity to the focus of the furnace where it is melted or sintered, then solidified and slowly and continuously removed from the focus.

These mountings require a certain amount of elbow room and space in which to work. The great advantages of having a stationary focus of direct access are apparent. All these operations can be performed in uncontaminated atmospheres, in the air, or in an oxidizing atmosphere. Special techniques permit performance of operations in a conditioned atmosphere.

Surface melting is effective with materials that have a good capacity for absorbing solar radiations. Other materials are best treated in special black-body furnaces which consist of an insulated cavity with an opening of approximately 100 deg through which the radiations can enter. Black-body furnaces developed at the Mont Louis laboratory in France (12) are water-cooled and can be rotated at speeds up to 5000 rpm. They permit purifying operations to be carried on at high-temperature levels.

Temperature and Flux Control. Control of temperatures and flux is obtained relatively simply by shielding part of the surface of the focus some distance away. In this way the quantity of sunlight and the flux available can be increased or decreased as desired. Temperature and flux measurements naturally can be performed with conventional means such as optical pyrometers and water-cooled, black-body cavities. Care must be taken in using optical pyrometers to distinguish between the direct radiation from the specimen that must be measured and reflected-sunlight radiations that may cause appreciable errors in the measurements (13).

Characteristics of Modern Solar Furnaces

This brief review has indicated the techniques and characteristics of solar furnaces. We will describe briefly certain installations that have been built abroad and in this country.

Mont Louis Laboratory. Important solar-furnace installations are located at Mont Louis in the Pyrenees. Here Felix Trombe and Marc Foex have established a comprehensive laboratory including six small furnaces of 5 ft diam and a large 35-ft unit, Fig. 6. All these utilize auxiliary mirrors to track the sun. The large unit is vertical and the targets therefore exposed sideways. Five of the small units are so arranged that the parabolic mirror is above the target and specimens can be exposed directly from above.

The principal difference between the 35-ft unit and the smaller ones is that the surface of the large unit actually consists of about 3500 small mirrors so arranged and curved that they form part of a large paraboloid surface. The smaller units were adapted from French Army searchlight mirrors and are in one piece. Similarly all the auxiliary heliostat mirrors used consist of many

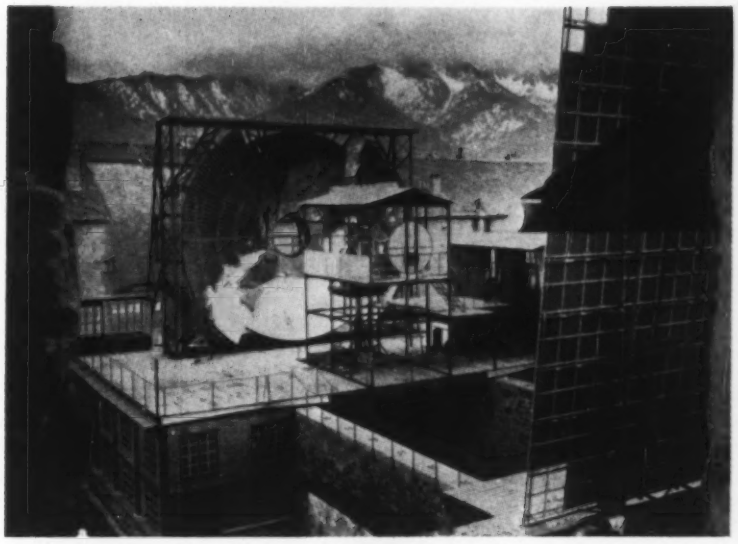


Fig. 6 General view of 35-ft furnace located at Mont Louis in the Pyrenees

smaller mirrors on one frame. Table 2 includes statistical data on the larger furnace.

These furnaces have been used in many high-temperature-research programs. These programs have been performed in oxidizing atmospheres and also in controlled atmospheres with special quartz containers. High-temperature refractory materials have been purified with extremely good results and the furnaces have been used in the production of cermets and other special alloys. Work also has been done with high-temperature-equilibria reactions such as the fixation of nitrogen.

The success of these programs has led the Centre National de la Recherche Scientifique to build a new furnace with a diameter of 200 ft (14). This unit will have an equivalent input capacity of about 1000 kw and will be located near the existing laboratories. It will be used in industrial programs sponsored on a co-operative basis by French industry and the French Government.

Algiers Furnace. Built at Bouzareah, near Algiers (11), this furnace was designed by Messrs. Betier and Guillemonat for use in nitrogen-fixation processes. No auxiliary mirror is used. The surface of the paraboloid has an outside diameter of 8.4 meters. It consists of 144 aluminum reflecting elements, specially electropolished for high reflectivity. The supports of the paraboloid, similar to those used for astronomical installations, permit the reflector to be oriented so that it can track the sun during the day. Although this unit is designed for higher temperatures than the Trombe furnaces, its cost is also much higher. It is reported to have cost about $350,000, whereas Trombe's 35-ft unit, which is bigger, is reported to have cost only $60,000. This difference is due principally to the simplicity of Trombe's design.

The furnace is presently being utilized by the Algerian Association for Solar Energy in a program of high-temperature research.

Other Furnaces Abroad. The National Physical Laboratory of India has built a slightly different furnace of lower flux intensity. An array of 192 mirrors of 1 sq ft each concentrates on a single target of 1 sq ft (15). The maximum concentration ratio is therefore 1 to 192 and the flux intensity is low. This furnace is therefore similar to the de Buffon furnace of 1774.

Small 5-ft furnaces also exist at the Solar Laboratory of the USSR Academy of Sciences, and the Government Industrial Research Institute at Nagoya, Japan (16). One is projected in Australia at the New South Wales University of Technology in Sydney.

California Institute of Technology. The first U. S. furnace built in 1932 at the California Institute of Technology utilizes lenses instead of a parabolic surface (9), Fig. 7. Nineteen lenses of 2 ft diam collect energy over a total area of approximately 57 sq ft. This energy is brought to the focal point by 19 secondary lenses and 18 oblique mirrors.

The unit is mounted like an astronomical telescope with rotation around the earth axis and a declination axis. The focal point remains fixed since it is at the intersection of these two axes. This furnace is now being used in a joint research program by the California Institute of Technology and Stanford Research Institute.

Conn Furnaces. Since 1940, W. Conn has built a number of solar furnaces with apertures varying from 60 to 120 in. (17). In general these units use no auxiliary mirrors and have been built with searchlight mirrors or with specially prepared aluminum sheets. One 120-in. unit was recently sold by W. Conn to Convair, a division of General Dynamics, at San Diego, Calif.

Recent Small Furnaces. A number of 5-ft units, often built with converted Army searchlight mirrors, are in use in the United States. Some of these are at Fordham University under the direction of Tibor S. Laszlo (18); at General Electric in Nela Park, Cleveland (16); at Arizona State College, Tempe, Ariz., at the Kennecott Copper Corporation in Salt Lake City; at the U. S. Bureau of Mines laboratories in Morgantown, West Va.; at Stanford Research Institute in Menlo Park, Calif.; and at Convair, a Division of General Dynamics, in San Diego, Calif.

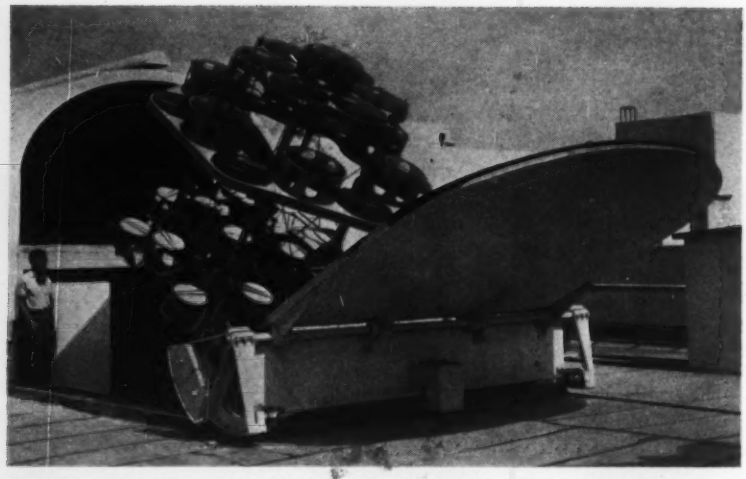


Fig. 7 First U. S. lens furnace built in 1932 at California Institute of Technology

A medium-temperature furnace was built at the Massachusetts Institute of Technology several years ago (19). It consisted of 400 flat mirrors concentrating on a single target and was similar to, although more complex than, the furnace built more recently by the Indian National Laboratory.

Proposed Air Force Furnace. The Air Force has recently announced (20) that a 200-ft solar furnace would be built near Alamogordo, New Mexico. Although little information is available at present regarding the proposed plans for this unit, there is little doubt that its construction and utilization will accelerate acceptance of solar furnaces for high-temperature industrial work in this country.

Wide Range of Usefulness. Solar furnaces are useful tools for high-temperature work up to 3000–3500 C. They can be used in experiments where lack of contamination from flames, combustion products, electrodes, and refractory fragments is important.

As the need for new high-temperature materials becomes more pressing, the solar furnace will be an important tool in research and development on new materials and in their industrial preparation. It is probable that this technique will prove useful to scientists once again, and the solar furnace ultimately may become as familiar to us as the Bunsen burner.

Acknowledgments. The authors wish to thank Stanford Research Institute for permission to use material developed on Institute-sponsored projects. The authors also wish to thank the Commander, Air Research and Development Command, Baltimore, Md., for permission to use material developed on SRI Project No. CU-1410 (Astia Document No. AD 81521).

Bibliography

1 "An Inquiry Into the Origin of the Discoveries Attributed to the Moderns," by L. Dutens, London, England, 1769, p. 324.

2 "La Dioptrique," by R. Descartes, Leyde, 1637, lecture viii.

3 "Experiences sur les métaux faites avec le verre ardent du Palais Royal," by M. Geoffroy, Mémoire de L'Académie Royale des Sciences, Paris, 1709, p. 162.

4 "Observations sur le fer au verre ardent," by M. Homberg, Mémoire de L'Académie Royale des Sciences, Paris, 1702, p. 158.

5 "Invention de miroirs ardens pour bruler grande distance," by G. L. de Buffon, Mémoire de L'Académie Royale des Sciences, Paris, 1747, p. 82.

6 "Nouvelle invention de miroirs ardens," by G. L. de Buffon, Mémoire de L'Académie Royale des Sciences, Paris, 1748, p. 305.

7 "Premier Essai du grand verre ardent," by A. L. Lavoisier, Mémoire de L'Académie Royale des Sciences, Paris, 1782, p. 62.

8 "Der Sonnen-Schmelzspiefel," by H. Straubel, *Zeitschrift für Angewandte Physik*, vol. 1, 1949, pp. 542–545.

9 "The Operation and Use of a Lens-Type Solar Furnace," by P. Duwez, T. E. Tietz, E. Loh, N. K. Hiester, Transactions, Conference on Solar Energy, University of Arizona, Tucson, 1956.

10 "L'Utilisation de l'Énergie Solaire. Etat actuel et Perspective d'Avenir," by F. Trombe, *Journal des Recherches du C.N.R.S.*, December 25, 1953.

11 "Un Essai industriel de captation de l'énergie solaire à Alger," by A. Guillemonat, G. Betier, Proceedings World Power Conference, Rio de Janeiro, 1954.

12 "Traitements à haute temperature au moyen de fours centrifuges chauffes par l'énergie solaire," by F. Trombe and M. Foex, Transactions, Conference on Solar Energy, University of Arizona, Tucson, 1956.

13 "Separation of Incident and Emitted Radiation in a Solar Furnace by Means of Rotating Sectors," by W. Conn and C. Braught, *Journal Optical Society of America*, vol. 44, January, 1954, pp. 45–47.

14 "High Temperature Furnaces," by F. Trombe, Proceedings World Symposium on Applied Solar Energy, Stanford Research Institute, Menlo Park, Calif., 1956, pp. 63–72.

15 "Articulated and Semi-Articulated Low Cost Hot Focus Solar Energy Concentrators," by A. L. Gardner, Proceedings New Delhi Symposium on Solar and Wind Energy, UNESCO, NS/AZ/191/Annex 2, 1954.

16 "Solar Energy Furnaces," by G. Benveniste, Stanford Research Institute, Menlo Park, Calif., 1955.

17 "Recent Progress in Solar Furnaces for High Temperature Research and Development Work," by W. Conn, *Journal of The Franklin Institute*, vol. 257, January, 1954, pp. 1–12.

18 "A Guiding System for Solar Furnaces," by T. S. Laszlo, W. F. de Dufour, and J. Erdell, Transactions, Conference on Solar Energy, University of Arizona, Tucson, 1956.

19 "A Segmented Mirror Solar Furnace for High Intensity Thermal Radiation Studies," by R. Gardon, *Review of Scientific Instruments*, May 25, 1953, pp. 459–63.

20 United States Air Force News Release, March, 1956.

Burning Fluid Coke

Steam-generating equipment developed to utilize by-product fuel from new cracking process

By Ollison Craig[1] and E. H. Smith[2]

Riley Stoker Corporation, Worcester, Mass.

THE fluid-coke process, developed by Esso Standard Research and Engineering Company, not only produces a greater yield of gasoline from crude, but also produces a by-product, fluid coke, that is becoming an important source of fuel for use in steam-power generation.

The over-all economics of a refinery operating with and without a fluid coker can be seen in the comparisons of yield as evidenced in Table 1. The fluid-coke process increases the percentage of yield of motor fuel almost 20 per cent. This additional increase in production makes the fluid-coke process particularly desirable in meeting the demand for increased production of gasoline.

Table 1 Fluid-Coke Process—Elk Basin Crude

Refinery product	Yield per cent—Without coker	Yield per cent—With coker
Motor fuel	40.0	47.6
Light fuel oil	26.9	26.9
Heavy fuel oil	3.1	6.2
Asphalt and road oil	6.9	6.9
Residual fuel oil	15.0	0.0
Coke	0.0	1.4
Consumed as plant fuel	8.1	11.0
	100.0	100.0

Carter Oil Company has been operating a fluid coker capable of producing 3800 bbl per day since early 1955. Esso Standard Oil's fluid coker went into operation in Baltimore in the latter part of 1955. The huge 42,000-bbl giant fluid coker at Tidewater Oil Company's new Flying "A" Refinery in Delaware goes on stream in the fall of 1956. The steam and power for this refinery will be supplied by three Riley steam-generating units designed specifically to burn fluid coke. These units will be owned and operated by Delaware Power & Light Company. Several other fluid-coking units are scheduled for other refineries.

The Fluid-Coking Process

The fluid-coke cracking process uses two large vessels—one known as a reactor vessel, the other a burner vessel. Fig. 1 shows the essentials of the process and how fluid coke is both the catalyst and a secondary by-product.

Seed coke is first heated in the burner vessel and then flows into the reactor vessel where coke comes into contact with the raw preheated feed stock. At that time the lighter fractions are flashed off. Additional coke is formed both as seed coke and in the growth of the heated coke particles coming from the burner vessel. The new coke is deposited on the seed coke in onionlike uniform layers and is discharged from the process in a hard spherical form in grains about the size of sand particles.

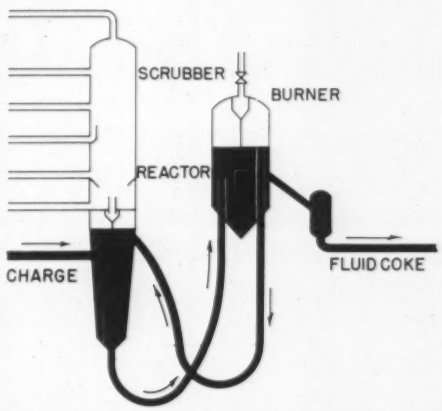


Fig. 1 Schematic diagram of fluid-coke process

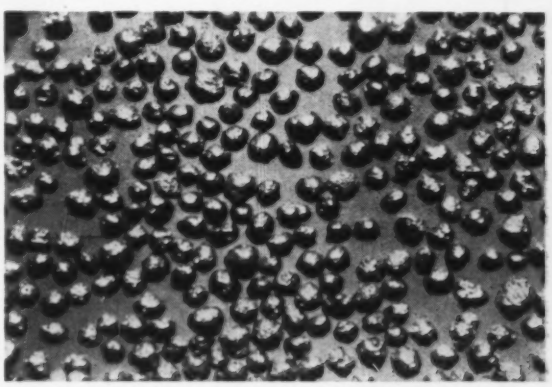


Fig. 2 Typical fluid-coke particles through 60 on 50 mesh

Properties of Fluid Coke. A photograph of the fluid coke is shown in Fig. 2, and in Table 2 the chemical properties are detailed.

[1] Vice-President. Fellow ASME (deceased April 3, 1956).
[2] Chief Engineer. Mem. ASME.

Contributed by the Fuels Division and presented at a joint session of the Fuels and Power Divisions at the Semi-Annual Meeting, Cleveland, Ohio, June 17–21, 1956, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 56—SA-63.

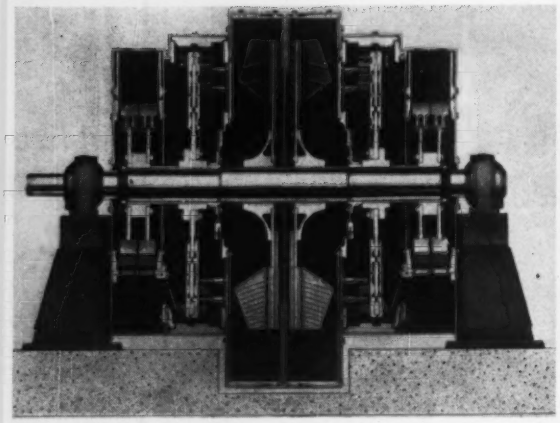


Fig. 3 Riley 50 Series pulverizer used in burning fluid coke

Table 2 Chemical Analysis—Fluid Coke

(August, 1955, Test—Carter Oil Coke)

Proximate analysis:	
Moisture, per cent	0.35
Volatile matter, per cent	5.75
Fixed carbon, per cent	93.88
Ash, per cent	0.12
Btu/lb	14403
Sulphur (separate)	3.75
Typical analysis of fluid coke from Carter Oil Company:	
Particle density	1.6
Heat of combustion	14000
Bulk density	55 to 65
Volatile heated to 1100 F	0.4
Volatile heated to 1742 F	3.8
Ash (Baton Rouge data)	0.11
Iron, wt per cent (below)	0.01
Nickel, wt per cent	0.01
Vanadium, wt per cent	0.03
Carbon, wt per cent	89.1
Hydrogen, wt per cent	2.1
Sulphur, per cent	6.1
Fusing temperature:	
Initial deformation, deg F	2270
Fusion point, deg F	2300
Fluid point, deg F	2350

The coke as discharged from the coker is finer than coke breeze. Screen analysis of one sample was found to be:

Per cent retained on	48 mesh	16
	60 mesh	26
	80 mesh	51
	100 mesh	70
	150 mesh	91
	200 mesh	98

The chemical analysis of the coke always shows about 90 per cent carbon, but the ash in the crude determines the chemical analysis of the ash of the coke so that wide variations are encountered. The ash content, however, is very low, usually less than 0.5. It is unlikely that all of the fouling troubles encountered when burning fuel oil in boilers will be avoided, but it is expected that the scrubbing action of the fly ash will lessen them.

Grindability. When the initial small quantity of fluid coke was received, an endeavor to determine grindability was made using a standard Hardgrove grindability machine. It was found that because of the spherical shape of the coke a modified procedure was necessary.

One procedure gave a grindability of 17.7, other procedures have shown as high as 36. It is possible also that the changes in the process produce coke of various grindabilities within the range given.

A test was made also with a miniature high-speed mill grinding by impact and by attrition. This mill-ground the fluid coke to a fineness comparable with 50-grindability coal. A series of tests was then made on various modifications of a Riley 50 Series pulverizer and an arrangement of internal parts was developed so that the mill produced a fineness of 85 per cent through 200 mesh, with a power consumption of less than 35 kw per ton when grinding coke at 40 per cent of rated mill capacity. It was found that an increased mill-discharge temperature produced both higher fineness and lower power. The tests were conducted with 400 F mill-discharge temperature. Fig. 3 shows the type of mill used in these tests.

Table 3 Typical Analysis of Cokes

	Fluid coke	Delayed coke	Metallurgical coke breeze (moisture- and ash-free)
Fixed carbon, per cent	94.1	90.2	94.3
Volatile matter, per cent	5.9	9.8	5.7
Size through 16 mesh, per cent	....	....	54.0
50 mesh, per cent	70.0	....	23.5
Ignition temperature, deg F			
Fluid coke			1400
Metallurgical coke			1150
Pulverized coal 44 microns 33 per cent volatile			1250
Reactivity,[a] deg C T_{18}			
Bituminous coal—Illinois #6 Seam			180
Bituminous coal—Pittsburgh Seam			230
Pocahontas #3 Seam			245
Fluid coke			348[b]
Metallurgical coke			500
Foundry coke			500

[a] "Physical Properties and Reactivity of Coke," by Martin Mayers, chap. 24, "Chemistry of Coal Utilization," H. H. Lowry, ed., John Wiley & Sons, New York, N. Y.

[b] "Fluid Coke," by F. H. Stracke and F. H. Schiffer, *Power*, vol. 99, December, 1955, pp. 102–105 and 198, 200, 202.

Ignition and Combustion. Typical coke analyses are given in Table 3. It will be noted that the reactivity of the coke is numerically lower than metallurgical coke, signifying that burning would be completed in a shorter time.

Comparison With Delayed Coke. Delayed coke is produced for the most part with a somewhat higher volatile content than fluid coke though some production very closely resembles fluid coke. The grindability is always higher.

Delayed coke is burned in water-cooled furnaces but usually requires 30 per cent auxiliary fuel. The per cent of auxiliary fuel can be reduced by covering large areas of the furnace with refractory.

Multinozzle Burner. In order to ignite fluid coke it is necessary to bring the temperature of the coke particles

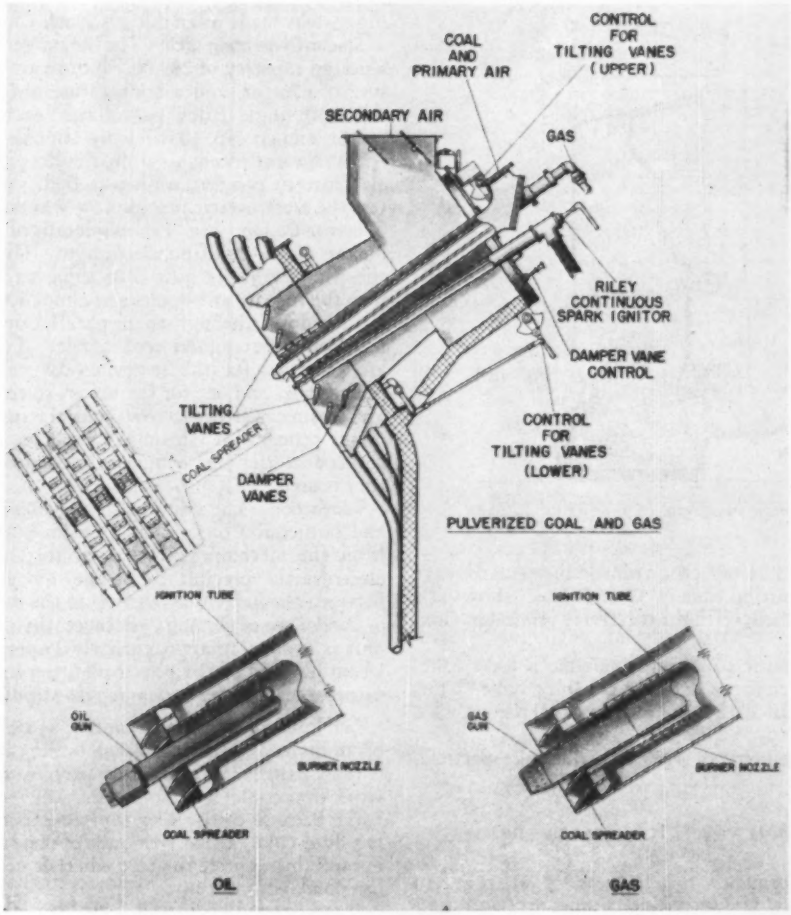


Fig. 4 Details of the Riley directional-flame burner used in the fluid-coke process

up to, and maintain it at ignition temperature. This can be accelerated by:

1 Highest possible primary-air and coke temperature.
2 Burner nozzles as small as practical.

With a number of small nozzles the surface of the fuel exposed to radiant heat from the flame is much greater than when a single large discharge nozzle is used. A burner of this type is shown in Fig. 4. The rectangular shape also gives a greater periphery than a circular nozzle.

Temperature of Primary Air. The temperature of the coke has to be raised to the 1400 F ignition temperature before burning can take place. The higher the initial temperature of the coke-and-air mixture, the quicker ignition will take place.

Primary-air and coke temperatures of 400 F have been used and still higher temperatures are contemplated in new designs. There have been no difficulties with these high temperatures with the Riley 50 Series pulverizer (Fig. 3) as the oil-cooled bearings are external to the machine.

No burner deposits have been encountered because of absence of tarry substance in the coke.

Furnace Design

General. A furnace of unique design shown in Fig. 5 has demonstrated its ability to burn bituminous coal with a very low carbon loss. Burning a hard high-swelling-index West Virginia coal in a 180,000-lb unit, a carbon loss of only 0.3 per cent is consistently obtained, whereas units of similar size fired with circular burners in the same plant produce carbon losses of about 2.0 per cent. With these results available, an analysis was made of the design shown to determine its applicability to burning fluid coke.

Ignition. Ghosh and Orning[3] found that low-volatile Pocahontas No. 3 Seam coal gave an ignition time of 32 millisec; Pittsburgh Seam coal, 28 millisec; and Illinois No. 6 Seam coal, 25 millisec. An analysis was made resulting in the curve, Fig. 6, where both reactivity and volatile matter are plotted against ignition time. The reactivity curve was extended to 348 for fluid coke, resulting in an anticipated ignition time of 41 millisec. Similarly the volatile-matter versus ignition-time curve

[3] "Influence of Physical Factors in Igniting Pulverized Coal," by Bimalendu Ghosh and A. A. Orning, *Industrial and Engineering Chemistry*, vol. 47, January, 1955, pp. 117–121.

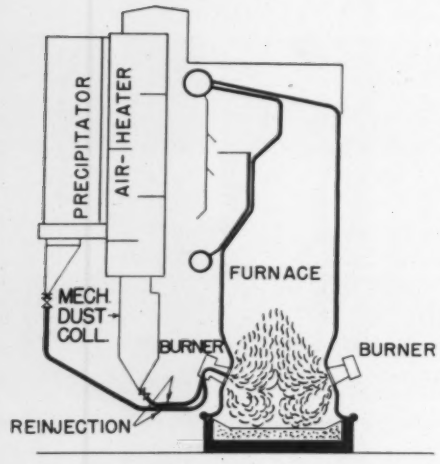


Fig. 5 Schematic diagram of fluid-coke furnace

was extended to 5.75 per cent volatile matter and gave an anticipated ignition time of 37.5 millisec, showing a rather close agreement with the reactivity versus ignition-time curve.

The foregoing anticipated ignition time is for a coke-air mixture of 50 cu ft per lb of air per lb of coke, a furnace temperature of 2012 F and a fineness all through 200 mesh.

For a nozzle velocity of 4000 fpm the coke particles would travel

$$\frac{4000}{60} \times 0.041 = 2.72 \text{ ft before igniting.}$$

In actual performance the fineness of 51 per cent through 200 mesh would increase the ignition time, but its effect would be more than offset by the 400 F primary-air temperature and a furnace temperature higher than 2012 F.

Observations showed that the coke air stream ignited about 12 in. from the burner nozzle.

Burning. By the time the coke particle has reached the center of the furnace its horizontal velocity is reduced to zero and the particle has acquired a vertical velocity as shown on the diagram. However, the particle is now burning in a temperature of approximately 3000 F, and it follows that with a flame front of this magnitude and temperature the burning of the coke particle will continue even if the vertical velocity were increased to about 10,000 fpm. The vertical velocity in the furnace at that point of least cross section is less than 2500 fpm, so that very stable furnace conditions can be expected.

Reinjection. Because the coke contains only from 0.10 to 0.30 per cent ash, all solids leaving the furnace are likely to contain a high percentage of carbon. Reburning this fly ash results in an appreciable decrease in carbon loss without exceeding the dust loading required by smoke regulations.

Field Test

Through the courtesy of Carbide & Carbon Chemicals Corporation, a boiler unit of the design illustrated in Fig. 5 was made available at South Charleston, W. Va.

Steam-Generating Unit. The steam-generating unit has a design capacity of 289,000 lb of steam per hr, at a pressure of 675 psi, and a temperature of 670 F. There are two 550 single Riley pulverizers, each with a 250-hp motor, and six No. 50 Riley directional-flame burners.

An efficient mechanical dust collector followed by an electrostatic precipitator is installed. At the time of the test the electrostatic precipitator was out of operation.

Burner Design. Fig. 4 shows details of directional-flame burner of the multinozzle design. The coal carried in the primary air is split into three streams discharging into the furnace at velocities of about 4000 fpm. Secondary air flows through three parallel openings each centered on a rectangular coal nozzle. Two control levers are provided for the secondary-air vanes, one for the upper vanes and one for the lower, so that the secondary-air stream can either follow parallel with or cross the path of the primary-air stream in whichever manner is needed to produce the best combustion conditions. No refractory is used.

Reinjection. The unit design provides for the collection and reinjection of fly ash (1) from boiler last pass, (2) from the mechanical dust collector, and (3) from the electrostatic precipitator. The fly ash is reinjected between the individual burners in the back row.

Conditions of Testing. Because this steam-generating unit is producing approximately 25 per cent of the total steam demand of the power plant serving vital chemical manufacturing operations, it was stipulated that:

(*a*) Pulverizers must be capable at all times of grinding bituminous coal to develop full boiler capacity.

(*b*) Changes to pulverizer parts must be limited to work that could be done in 8 hr.

(*c*) Because of the very limited experience with burning fluid coke, a small amount of residual gas should be burned throughout the test whether needed for supporting combustion or not.

Items (*a*) and (*b*) placed some limitations on the extent to which pulverizer parts could be altered.

For a period of 45 min prior to the start of the fluid-coke test the unit was fired with residual gas to purge the setting in so far as possible of bituminous-coal ash particles.

Fluid-Coke Test Results

Fluid-Coke Fineness. Fluid-coke fineness was required as follows:

Average grinding rate each pulverizer, 9840 lb per hr
Fineness per cent through 50 mesh, 99.9
Fineness per cent through 200 mesh, 51.6

Fluid-Coke Combustion. Ignition was rapid. The envelope of the coke stream ignited about 1 ft from the burner nozzle. Relatively little flame was observed above the burner level. It was noteworthy that the furnace was clearer than with bituminous-coal firing. The flame was very stable. This was indicated by inspection through the furnace observation doors and by absence of fluctuation of furnace draft gages.

Furnace-Bottom Temperature. Readings were taken at the center of the furnace and these showed a temperature of 2790 F.

Dust Loading and Carbon Loss. The dust loading of the gases into and out of the Western Precipitator Multiclone

Table 4 Carbide & Carbon Corp. Test—Fluid Coke

(For analysis refer to fuel analysis, Table 2)

Load K Btu above feedwater temp	287000
Combustion performance:	
Excess air, per cent	20.0
CO_2, per cent	15.6
Carbon loss, per cent heat in fuel	1.64
Dust entering mech. collector, per cent carbon	74.6
Dust loading in mech. collector at 340 F, gr/cu ft	5.04
Dust loading into stack at 310 F, gr/cu ft	0.028
Auxiliary fuel:	
Per cent heat input (average)	12.6
Per cent heat input (minimum)	9.0
Efficiency:	
Over-all efficiency	89.0
Air-heater exit temperature, deg F	340
Furnace data:	
K Btu/cu ft/hr	15.7
K Btu/sq ft/hr	73.5
Pulverizer performance:	
Average grinding rate during mill test	9840
Fineness through 50 mesh, per cent	99.9
Fineness through 200 mesh, per cent	51.6
Mill exit temp, deg F	374

was determined by standard dust-collector testing procedure. The test was made by a team of Prat-Daniel and Western Precipitator engineers.

The discharge from the stack gave a zero smoke reading on the smoke chart as against 25 per cent with bituminous. The dust loading of the discharge gases was determined to be 0.028 grain per cu ft, but the amount of sample was so small that this figure was discarded.

An adequate sample was obtained of the fly ash entering the multiclone. This gave 5.04 grains per cu ft at 340 F as shown in Table 4.

The multiclone was guaranteed for 78.6 per cent efficiency with pulverized-coal fly ash. The size consist of the coke fly ash and the high density of the particles themselves increased this efficiency to 90 per cent.

Fly-Ash Loss Calculations. Fly-ash loss is calculated as follows:

5.04 grains/cu ft at 340 F
1845 cu ft of gas at 340 F

$$= \frac{5.04 \times 1845}{7000} = 1.33 \text{ lb per sec}$$

The analysis of the sample from the induced fan discharge gave:

	Per cent
Combustible	25.15
Ash	74.85

However, the sample was so small that no great reliance can be placed upon its being a representative sample. The carbon-loss determination has been made therefore on two premises:

1 That the dust loading in the gas leaving the dust collector had the same carbon content as the inlet.

2 That the dust loading in the gas leaving the dust collector had a carbon content lower than that of the fly ash entering, and a conservative figure of 50 per cent carbon was assumed.

Dust Collector. The calculation for dust collection follows:

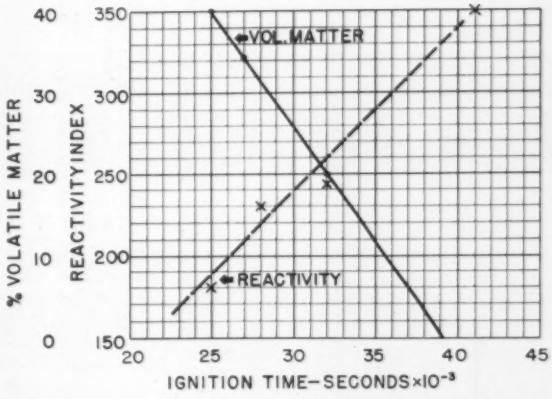


Fig. 6 Reactivity curves of fluid coke versus ignition time

Per cent carbon in dust collector catch = 74.6
Fly ash out of stack/sec = 0.133 lb
Carbon out of stack/sec = 0.100 lb
Carbon loss, per cent = 1.64

All tests of combustible content of fly ash show lower carbon content in the smaller fractions so that the dust leaving the stack contained probably 50 per cent carbon, in which case:

Carbon out of stack/sec = 0.067 lb
Total heat input to boiler/sec = 89,300 Btu

$$\text{Carbon loss} = \frac{0.067 \times 14{,}600}{89{,}300} = 1.09 \text{ per cent}$$

Dust Loading to Stack. Dust loading to the stack is calculated as follows:

Fly ash into dust collector = 1.33 lb/sec
Fly ash into electrostatic = $1.33 \times 0.10 - 0.133$ lb/sec
Cu ft of gas at 340 F = 1845 cu ft/sec

$$\text{Grain/cu ft} = \frac{0.133 \times 7000}{1845} = 0.506 \text{ grain/cu ft}$$

Corrected for a 50 per cent excess air and 550 F = 0.315 grain/cu ft. (This last figure is before precipitator.)

Estimated efficiency of precipitator, 81.6 per cent

Estimated fly ash per cubic foot to stack with electrostatic precipitator in operation = $0.316 \times 0.184 =$ 0.058 grain/cu ft

Conclusions

1 A different furnace design from that used for anthracite is desirable because of the minute quantity of ash.

2 Efficiency of burning is enhanced by a high primary-air temperature.

3 Burner design must permit fast heating of the coke particles by the radiant heat from the flame.

4 Reinjection from the dust collector is practical and results in an increase in efficiency.

5 Opposed firing inclined downward produces a very stable flame with little or no auxiliary fuel.

6 Opposed firing inclined downward is effective in burning fluid coke with low excess air and very low carbon loss.

Human Engineering—

A New Approach to Operational Design[1]

By George A. Peters, Jr.

Human Engineer, Samuel Feltman Ammunition Laboratories, Picatinny Arsenal, Dover, N. J.

THE very concept of automation implies some reduction in the number of workers involved in any given work process. The workers who remain usually have increased responsibility in terms of the cost of equipment and control of materials with which they work. It is also true that, in almost every phase of our industrial and military activity, the financial responsibility and complexity of service demanded from the individual worker have been greatly amplified. With such continually increasing demands upon the human component of the more and more complex man-machine systems, it is quite logical that there should be considerable attention focused upon the human factors involved for optimum equipment operation.

At first, consideration of such human factors was limited to time and motion studies. Then, personnel selection and placement of the best-qualified workers helped to increase machine productivity. However, these procedures dealt only with improving the human operation of existing equipment. The individual worker was considered the variable which had to adjust to the machine system. In the design of equipment, emphasis was placed on improvement of the machine itself with little, if any, attention on the interaction of the machine and its human operators. Even if there were some interest, little could have been done because of the lack of readily available factual information on how design might have been improved in terms of human capabilities, limitations, and variability.

Designing for the Human Being

The transition of workers' operations from simple manual manipulations toward increasingly complex discriminative, interpretive, and decision-making functions has stressed the need for design in terms of human capability and variability. There also has been additional pressure to make even the simple human operations more "natural" for ease of machine operation and for customer sales appeal.

The source of basic information concerning the human operator had to come from those sciences which study the human directly; i.e., psychology, anthropology, sociology, anatomy, and physiology. The experimental psychologist apparently had the necessary training and experience to interpret pertinent scientific data in terms of appropriate design recommendations. The experimental psychologist, furthermore, had training in the specialized experimental techniques which could be used to solve specific problems in this applied scientific adjunct to design engineering.

From this activity, the new field of "human engineering" has emerged. Although it is composed primarily of experimental psychologists, a wide variety of scientific disciplines is represented. Of course, it does not replace any existing design function but actually broadens the range of design possibilities by adding a valuable adjunct to the design team.

It would seem that basic courses in human engineering should be an integral part of the formal education of all engineers. Just as physics is taught by physicists who gather and interpret the basic research data of their field, skilled representatives of this new discipline could provide the necessary cross-fertilization to make such teaching a dynamic experience in the educational life of the engineering student. Although this applied science is still in its infancy, there are some good textbooks[2,3] and standard references[4,5,6] now available.

Organizing Human-Engineering Knowledge

As with all emergent groups who have common occupational interests, there is a natural desire to band together to facilitate the flow of information and have some organizational structure to advance common purposes. Hatch,[7] for example, has suggested constructively some affiliation with the ASME. There have also been attempts to organize in affiliation with the American Psychological Association. Certainly psychologists have no monopoly on human engineering, and most engineers would not wish to undergo the intensive and lengthy training for such specialization.

If there is to be some formal organization of human engineers, by the very nature of the discipline it should include members from all the sciences capable of making constructive contributions to the field. It has to be all-inclusive rather than restrictive if the great potential of the field is to be realized rather than hindered in its growth. Thus it should include members from the basic disciplines of psychology, engineering, anthropology, physiology, sociology, medicine, mathematics, statistics, physics, and anatomy, as well as those engaged in the more or less similar applied sciences of biomechanics, engineering psychology, biotechnology, applied experimental psychology, psychophysiology, psychotechnology, and ergonomics. Perhaps it is still too early for such a formal organization, but certainly some opportunity for communication and expression among *all* of these varied workers should be forthcoming.

[1] The opinions expressed in this paper are those of the author and do not necessarily reflect the views of any government agency.

[2] "Human Engineering Guide for Equipment Designers," by W. E. Woodson, University of California Press, Berkeley, Calif., 1954.

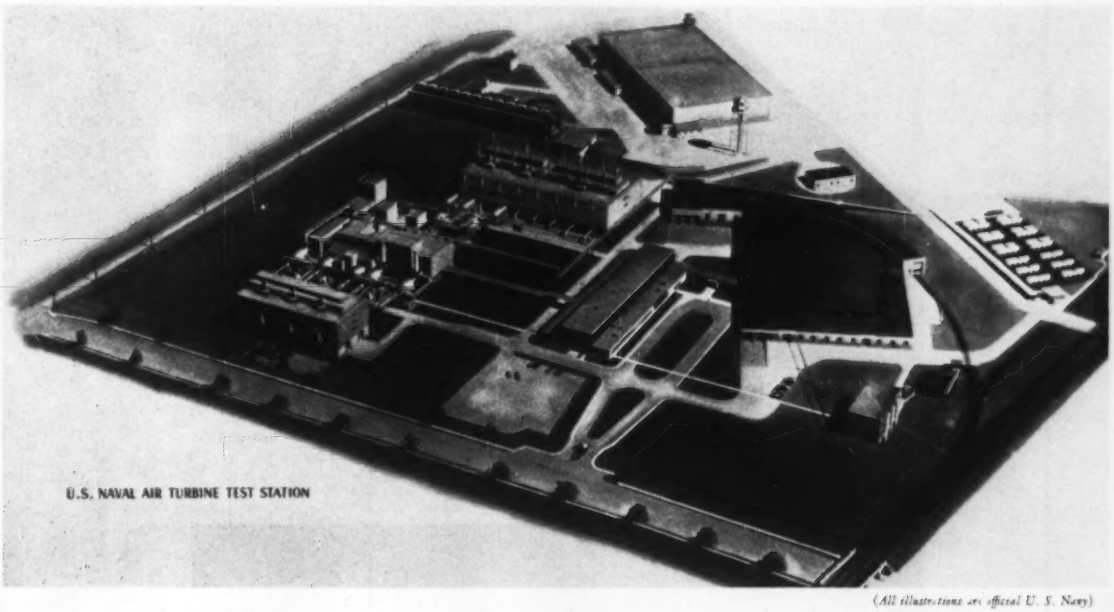
[3] "Applied Experimental Psychology: Human Factors in Engineering Design," by A. Chapanis, W. R. Garner, and C. T. Morgan, John Wiley & Sons, New York, N. Y., 1949.

[4] "Handbook of Experimental Psychology," by S. S. Stevens, John Wiley & Sons, New York, N. Y., 1951.

[5] "Human Factors in Air Transport Design," by R. A. McFarland, McGraw-Hill Book Company, Inc., New York, N. Y., 1946.

[6] "Handbook of Human Engineering Data," second edition, rev., Tufts College Institute for Applied Experimental Psychology, and Special Devices Center, Office of Naval Research, Medford, Mass., 1952.

[7] "Proposed Program in Ergonomics . . Human Engineering," by T. F. Hatch, MECHANICAL ENGINEERING, May, 1955, pp. 394–395.



(All illustrations are official U. S. Navy)

Fig. 1 Perspective view of the general laboratory area of the U. S. Naval Air Turbine Test Station at Trenton, N. J.

Test Facilities—Aeronautical Turbine Laboratory

Facilities and test services provided at the U. S. Naval Air Turbine Test Station

By L. G. Tilton

Supervisory General Engineering, Director of Design Division, U. S. Naval Air Turbine Test Station, Trenton, N. J.

The Naval Air Turbine Test Station (NATTS) as a field activity of the Navy Department's Bureau of Aeronautics was commissioned July 1, 1951, with the assigned mission of the "test and evaluation of aircraft turbojet, turboprop, ramjet, and pulsejet engines, and accessories and components of such engines." The Aeronautical Turbine Laboratory (ATL) as the operations department of NATTS is served by the several other departments of the station. The station is located on Parkway Avenue in the Township of Ewing which adjoins Trenton, N. J. Excellent highway and railroad facilities serve the site and the Mercer County Airport adjoins the station property, affording air transportation for both passenger and freight traffic.

Aeronautical Turbine Laboratory (ATL)

The test facilities of the ATL consist of three main buildings: High-pressure-blower wing, test wing, and altitude exhauster wing. Fig. 1 shows a perspective view of the general laboratory area while Fig. 2 shows a plan view of the three main buildings, major connecting pipes, and some secondary facilities.

High-Pressure-Blower Wing. The high-pressure-blower wing is a four-deck structure which houses the ram blowers with necessary step-up gears and drive motors, refrigeration equipment, and components necessary for simulating ram-air pressures and altitude temperatures. Ambient air is drawn through louvers in the side of the building and passes through oil-bath filters, silencers, ram blowers, check valves, and into the first set of three sets of air-treating rigs. These rigs are located within the building and each is a duplex heat exchanger, the first section being a water-to-air exchanger and the second section a Freon-12-to-air exchanger. This rig partially dehumidifies the air and cools it to 40 F. The air is then piped to the second set of air-tempering rigs located along the north side of the building. Here the air is further cooled to a temperature of —23 F and a moisture content of 1.5 grains per lb of air in a Freon-12-to-air exchanger. The air is then piped to the combustion-air manifold system where, by a proper sequen-

Contributed by the Aviation Division and presented at the Semi-Annual Meeting, Cleveland, Ohio, June 17–21, 1956, of The American Society of Mechanical Engineers. Condensed from ASME Paper No. 56—SA-72.

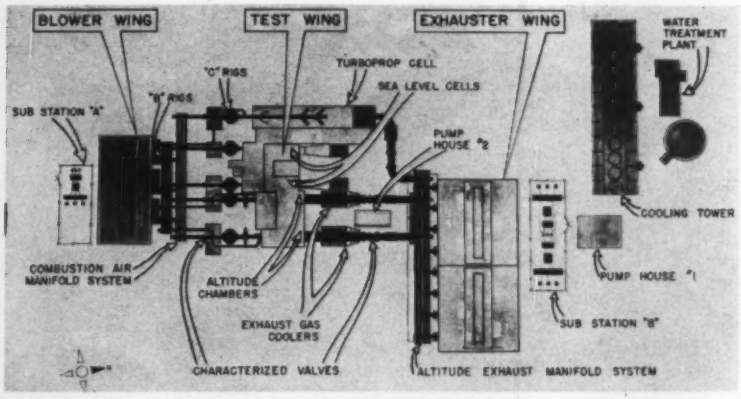


Fig. 2 Plan view of laboratory area, showing arrangement of main buildings, major connecting piping, and secondary facilities

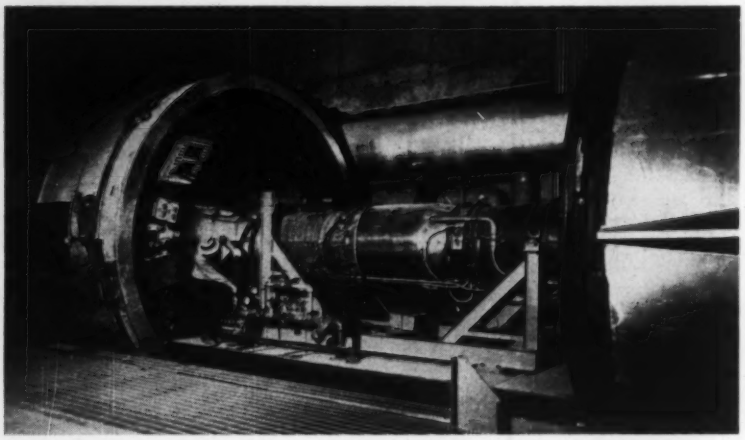


Fig. 3 Altitude chamber with test section open, showing terminal boxes and panels mounted inside which are connected to control-room instrumentation

cing of valves, it may be directed to any one or more test areas. However, in the main headers leading to each of the existing test cells there is located a third air-conditioning rig and this is the point of control for the final air temperature entering a test cell. The air from the latter rig is controllable from a low of —67 F to temperatures necessary to simulate aerodynamic heating.

Blowers are equipped with inlet prerotation vanes, and drive-motor speed control is provided by liquid rheostats. An automatic-surge by-pass system also is provided for each blower. When conducting tests under simulated altitude conditions, the blowers may be bypassed by opening the valve in the line from the inlet side of the blower to a point in the combustion-air line between the check valve and the inlet to the primary rig. Final combustion-air pressure at the inlet to a test engine is controlled by a characterized valve located in each of the five main air headers.

The ventilation for the entire building is provided by a series of low-head high-cfm fans and ducting system. All atmospheric bleeds, intake, and discharge pipes to this building are acoustically treated so that ambient noise level in surrounding areas is not appreciably affected.

Test Wing. The test wing is a four-story structure which houses two altitude chambers, two turbojet cells, one turboprop cell, their respective control rooms plus the necessary instrumentation, fuel rooms, engine preparation areas, operations control center (monitoring area), and other supporting services. Each test area is specifically sound-treated to afford the necessary decibel reduction over a prescribed frequency range so that the noise level in the vicinity is kept to a minimum.

The two altitude chambers, together with their control rooms, fuel room, and auxiliary areas, are housed in the test wing. Each altitude chamber consists of an inlet section, a center or test section, and an exhaust section. The center section telescopes over the smaller inlet section moving on wheels riding on standard railroad rails. The positioning of this section is accomplished by means of a hydraulic motor operating a pinion gear on a rack.

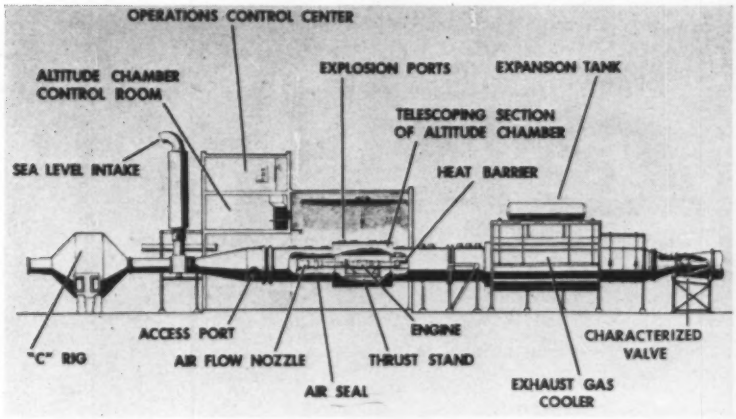


Fig. 4 Sectionalized view through altitude test chamber and associated equipment

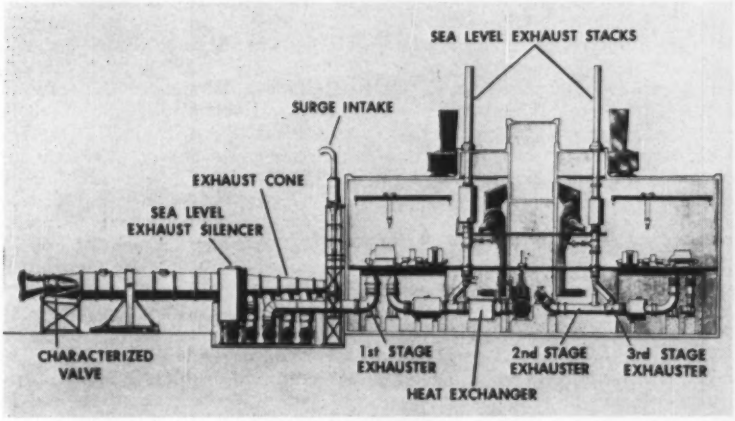


Fig. 5 Section through exhaust wing and exhaust-gas system of the altitude facility

When the center section is open, engines may be easily placed in the test stand, and mechanics have easy access to the engine. When the center section is in the closed position, it is mechanically locked and then sealed by inflating a rubber seal.

Fig. 3 shows an altitude chamber with the center section open. The aircraft engine undergoing test is mounted in its fixed test stand which is in turn secured to a flexure-supported thrust platform. The thrust load is transferred to a hydraulic load-measuring cell located outside the chamber by a series of flexures and linkage members. Terminal boxes and panels permanently mounted inside the chamber and connected to control-room instrumentation facilitate the connection of test points on the engine to the control room for indication of engine performance.

Within the fuel-preparation room is located all equipment and services necessary to meter fuel flows and condition such fuel to any desired temperature from −65 to +175 F. An air seal is provided around the duct connecting to the inlet of the test engine and a heat dam is provided at the exhaust end of the engine which prevents recirculation of hot gases around the engine. The hot engine-exhaust gases from the test engine are cooled in an exhaust-gas cooler connected to the exhaust section of the altitude chamber.

A sectionalized view through the test wing, altitude chamber, exhaust-gas cooler, and so on, is shown in Figs. 4 and 5.

Turbojet Cells (Sea-Level Test). The two turbojet cells are housed in a three-level section of the test wing as shown in Fig. 6 and have a common control room, an engine-preparation room, individual fuel rooms, and other auxiliary areas. The test bed consists of a series of railroad rails welded to structural members and resting on, and isolated from the rest of the building structure by, layers of cork. The area outside and between the inner rails is poured with concrete. The test engine is mounted on a stand incorporating flexure supports and thrust-loading devices.

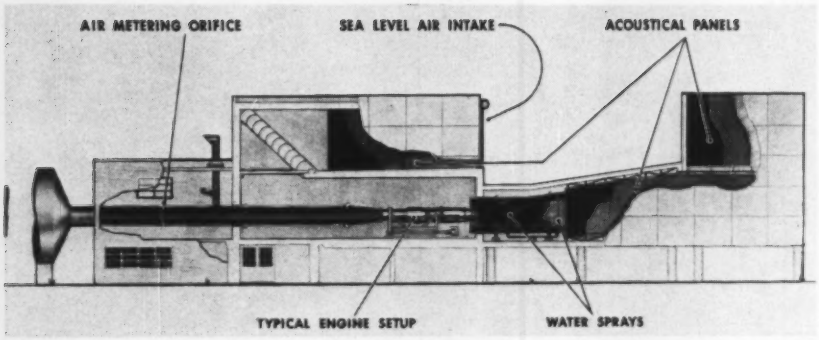


Fig. 6 Cutaway view of turbojet cell housed in three-level section of the test wing

Turboprop Cell. The turboprop cell is an L-type test area housed in a two-level structure, which consists of the engine test cell, test control room, a fuel-preparation room, and other auxiliary areas. A sectional view through the turboprop cell is shown in Fig. 7.

The test engine is mounted on a cable-supported platform and for altitude operation, combustion air is piped to the compressor inlet and the exhaust gases are piped to the exhaust-gas cooler and then through a characterized exhaust valve on to the exhaust-manifold system. Sea-level air to load the propeller, or propellers, or combustion air when desired for engine sea-level operation, is brought in through acoustic baffles at the front of the cell and directed to the propeller of the test engine by means of a variable-area orifice.

Altitude Exhauster Wing. The exhauster wing is a four-deck structure housing equipment, services, and components necessary to handle the gas-volume flow in simulating altitude exhaust conditions up to 65,000 ft at the exhaust end of the test engines. The basic equipment consists of eight first-stage exhausters, four second-stage exhausters, and two third-stage exhausters, with their respective step-up gears, electric-drive motors, and the necessary auxiliary and control equipment. The simulated conditions representing exhaust pressures from 30 in. Hg abs to 1.7 in. Hg abs are available currently to both the altitude chambers and the turboprop cell.

Secondary Facilities

Cooling-Water System. Water is pumped approximately 2 miles from the NATTS river pumping station on the Delaware River to a water-treatment plant, adjoining the cooling tower, and then to the reservoir under the cooling tower. Water used in and about the laboratory is handled in two separate systems. The water circulated through the first-stage coils of the altitude-chamber exhaust coolers operates in a closed circuit at 215 psi pressure and temperatures up to 375 F. The heat thus absorbed from the engine exhaust gases is dissipated to the cooling-tower water through water heat exchangers located in pump house No. 1. All other cooling water is pumped from the cooling-tower reservoir and returned through the tower for evaporative cooling. Effectiveness of the cooling tower is increased by thirteen forced-draft fans mounted atop the tower which may be operated, as required.

Fuel Storage and Supply. Test fuels are stored at the fuel tank farm consisting of eighteen 25,000-gal tanks, mounted above the ground level, providing a total storage capacity of 450,000 gal. A fuel-pumping station, located at the tank farm, circulates fuel through four 4-in. overhead lines to the individual fuel-preparation rooms near the several test areas. Two 2-in. fuel lines parallel the 4-in. lines from the tank farm should it be necessary to handle special fuels. All facilities are currently available for delivery of fuels by either tank car or tank truck.

Electric-Power System. Power is supplied to the station at 132,000 volts in quantities up to 50,000 kw by the New Jersey Public Service Electric and Gas Company. The contract provides that the quantity may be increased to 100,000 kw by negotiation and the presently installed transmission system is designed to carry that load. The power is delivered to a Navy-owned electric metering station.

Power is transmitted from the metering station to substations "A" and "B," shown in Fig. 2, through an underground oil-filled cable. Voltage is reduced to 13,200 volts at the substations and is distributed at this level to the blower and exhauster motors and to the several power centers about this station at which points voltages are stepped down to 440, 220, and 110, as required.

Supporting Shops. The necessary supporting services and facilities required to enable the test facilities to operate effectively are located in the main shop wing and the auxiliary shop wing. The main shop wing provided facilities for teardown, inspection, assembly, and instrumentation of test engines. Engine modification, repair, and the fabrication of special instruments and fixtures are also done in this building. In addition, rooms are provided for instrument calibration, instrument repair, inspection of classified engines and parts, parts cleaning and flow detection, engine cleaning, shop offices, and so on. The main section of this wing is occupied by the machine tools necessary to the manufacture of new, or modification of existing, articles required by the test programs. The auxiliary shop wing houses an electric shop, metal shop, weld shop, and live- and dead-storage areas. Material-handling facilities provided consist of two truck-loading docks and a railroad siding.

Instrumentation. Over-all control of the laboratory equipment is monitored from the operations control

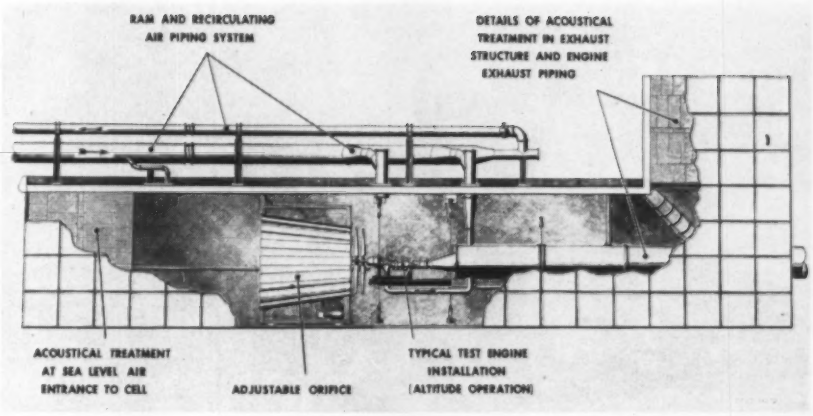

RAM AND RECIRCULATING AIR PIPING SYSTEM
DETAILS OF ACOUSTICAL TREATMENT IN EXHAUST STRUCTURE AND ENGINE EXHAUST PIPING
ACOUSTICAL TREATMENT AT SEA LEVEL AIR ENTRANCE TO CELL
ADJUSTABLE ORIFICE
TYPICAL TEST ENGINE INSTALLATION (ALTITUDE OPERATION)

Fig. 7 Sectional view of the cell used for conducting tests on turboprop engines

Table 1 Types of Tests Conducted at ATL

Steady-State Tests	Transient Tests
Engine qualification	Fuel-control evaluation
Military ram-power rating	Altitude starting procedures
Altitude performance and evaluation	Wind-milling investigations
Accessory qualification	Service operating-trouble investigations
Service operating-trouble investigations	Fuel evaluation
Component evaluation	**Environmental Tests**
Fuel evaluation	Cold starting
Propeller-vibration surveys	Inlet icing
Propeller qualification	Functional accessories
Development of new qualification procedures	Anti-icing verification
Substitute-materials investigations	Desert starting
Afterburner-performance investigations	
Compressor air bleed	

center. A graphic panel installed in this control center shows schematically the combustion-air flow from the blower wing to the five test areas, and flow of the engine exhaust from the test areas through the exhausters to atmosphere. Instrumentation is included in this area for remotely setting and indicating pertinent temperatures and pressures, opening and closing combustion-air and exhaust-gas valves, and permissive control over the start-up of plant equipment. The actual starting and stopping of the plant machinery is controlled by the operator located at the individual machine control panels.

An adequate supply of the various instruments required to indicate operating variables throughout the engine is available as required.

Heating Plant. The heating plant supplies steam for both comfort and process heating. The brine heat exchangers for the combustion air-treating rigs, and the heat exchangers used to heat the fuels and lubricating oils, are served from this source of steam. The plant consists of three oil-fired boilers rated at 117,000 lb per hr at 200 psi.

Test Programs

The types of tests conducted at the Aeronautical Turbine Laboratory are classified in three main groups (as listed in Table 1): steady-state testing, transient testing, environmental testing.

Steady-state testing represents the major segment of the test program since qualification testing of engines and accessories falls in this category.

Transient testing is conducted to determine the characteristics of components and accessories during acceleration and deceleration. Dynamic instrumentation is installed to record pertinent engine variables during these tests.

Environmental testing is conducted to insure the performance of engine components and accessories under extreme temperature and humidity conditions, such as are encountered in arctic or desert areas.

Expansion

The design of the test facilities at the ATL has recognized the need for ease of adaptability to any assigned test program, and the general configurations and services available to the several areas have been dictated by such considerations. Equal consideration has been afforded to the means for an orderly expansion of the current test facilities both as to increase in weight flow, and number and types of test areas. At the present time, contract drawings and specifications are being prepared for the enlargement of the blower wing. This will house an additional ram blower, additional refrigeration equipment, air-treating rig, and other supporting services.

Contract drawings and specifications also are being prepared for an additional altitude chamber and associated equipment which is being sized for double the weight flow of the existing chambers and for an environmental cell which is being designed not only to handle the environmental portion of engine-qualification tests but also will be provided with ram-air and altitude-exhaust services.

Future proposed expansion includes additional blowers for increased weight flow and pressure to the test areas, additional sea-level test cells, facilities for handling high-energy fuels, high-temperature heat generators, accessory and control systems test facilities, altitude test stand, and modifications and additions to the air-distribution system as required to maintain maximum flexibility throughout the several test areas.

This German city presents a scene of utter devastation following a series of World War II bombing attacks

Industry Under Enemy Attack

By B. W. Bruckmann

Manager, X207 Project, AGT—Jet Engine Department, General Electric Company, Cincinnati, Ohio

Living in the H-bomb age as we do, the importance of systematic planning for industrial continuity following an enemy attack cannot be overemphasized. Such continuity demands that the individual be instructed in the means of survival, for there is a direct relationship between individual welfare and industrial continuity. There must be protection of both industry and the individual, preferably underground. There must be stock-piling of weapons, of substitute electric-power and communications facilities, and of basic essential commodities—food, water, fuel, and medical supplies. Emergency plans must be set up for both industry and community. Passiveness toward planning and organization must be thoroughly dispelled.

TODAY, with the H-bomb and even more destructive nuclear devices measured in equivalent TNT-megatons, we know that the Hiroshima atomic-bomb blast of just a little over ten years ago was but a poor preview of what is possible now. But, do we fully realize what this means to our survival chances in a future war? I fear the U. S. public, including industry, does not.

If World War III were to start today, our nation's Strategic Air Command would probably strike first the enemy's airdromes, followed immediately by devastating attacks on the enemy's industrial resources.

This we know to be true, and we give a potential enemy credit for a similar concept of waging and possibly winning a global war. It is generally recognized that industry, as well as our military organization, no longer has a cushion of time or space to fall back on in preparing the weapons and defenses of war for a global conflict. It should be equally obvious, when total destruction of vital U. S. industry is possible in virtually no time, that this industry should be prepared to protect itself in an effort to survive.

In one of the very best publications on the problem of defense and survival during a possible future war I read the following sentence: "Precisely what one means by 'winning' a war, particularly in the age of the H-bomb, is hard to pin down. In general, however, the greater the supply of essential goods and services that remain after an enemy attack, the greater will be the chance of survival and victory."

Fundamentally true as it is, this statement does not describe what comprises the "remaining goods and services." It would be rather difficult to specify them in more detail because their requirements naturally depend to a large degree on the kind of aggressive weapons, the techniques and methods of their delivery, and

Contributed by the Production Engineering Division and presented at the Semi-Annual Meeting, Cleveland, Ohio, June 17–21, 1956, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 56—SA-8.

on the degree of ruthlessness with which the aggressor has decided to apply them.

The aggressor has an infinite variety of aggressive methods from which to choose. He can plan in advance and prepare in detail some carefully selected methods and can change them rapidly if warranted. Additionally, the advantage of surprising his victim is on his side.

In order to compete successfully, any defender would have to be prepared for such a tremendously wide field of possibilities that it seems rather doubtful that such preparation could be effected. This is the problem with which industry under enemy attack might be confronted.

A closer look at this statement and some of the factors of paramount importance seems to be in order. One such factor is time.

Before the advent of the A-bomb a defender still had some time left to successfully develop and apply defense methods to new weapons. (Example in the more recent history: The German V-1 and the British methods of defense.) After the A-bomb, and more specifically in the era of the H-bomb, this chance may have vanished completely.

Impact of Modern War

The advent of the A-bomb definitely marks a turning point in the problem of survival of a nation under determined ruthless aggression. The magnitude of impact and the variety of aggressive weapons and their delivery techniques are developing increasingly faster, so that it is considered nearly impossible today to develop corresponding means for successful protection and defense simultaneously.

This fact becomes more clearly visible with the following comparison. The actual total tonnage of TNT bombs dropped on German territory during the period from 1939 through 1945 amounted to 1,500,000 tons. This would presently be equivalent to 100,000 TNT-bomb flights, 60 A-bomb flights, or only 1.5 H-bomb flights.

This is naturally a theoretical comparison only, because the real impact of A or H-bombs as compared to the equivalent TNT-bomb tonnage cannot be measured realistically. The figures presented, however, may be used to visualize how many less bombs or flights, respectively, would be needed today to achieve a somewhat comparable impact.

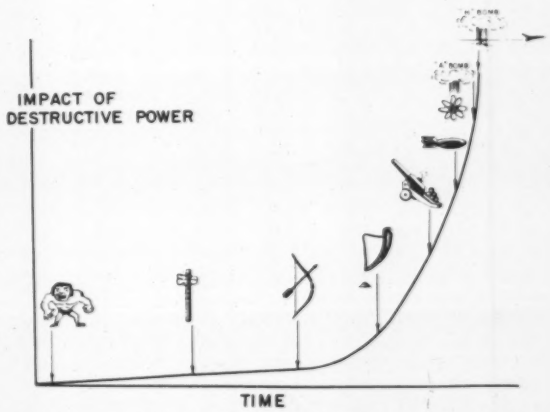
Even though the figures are theoretical, I think it is safe to say that our Strategic Air Command could, from dawn to sunset, carry more destructive force against enemy targets than was brought against Germany during all of World War II. It should be equally obvious and very well kept in mind that our own industrial targets would be just as vulnerable!

Vulnerability Factor. Another factor which has to be considered may be call the "vulnerability factor." Any kind of bomb dropped on a slightly inhabited area will naturally have little or no impact. Similarly, bombs dropped on a country with a poorly developed civilization will have only a small impact. This is specifically true when such a country has a vast surplus of population and when this population depends on rather primitive means for its existence.

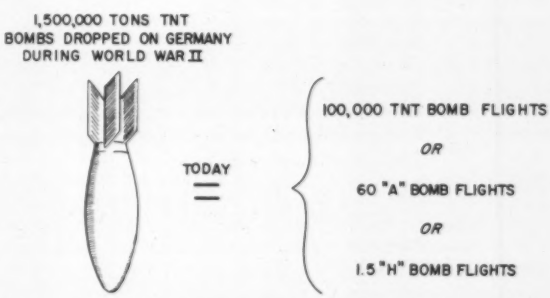
Countries such as ours, however, are at a definite disadvantage when this factor is to be considered. Our life depends to an extremely large degree on a myriad of facilities in all the areas which during a war become extremely critical. I am talking principally about our transportation and communication systems and all kinds of commodities and supplies we so largely depend upon.

Is it not true that even during nearly every heavy thunderstorm part of our telephone and electric-power supply systems are damaged? Both these systems are usually mounted on utility poles and run unprotected above the ground. How often have you found yourself in such a condition that during or after a heavy thunderstorm you wanted to call the doctor, the fire department, the police or the service office of the power and light company, and you could not?

The electric light was out. Your stove, refrigerator, heating system, and deep-well pump went dead. You suffered from chill, hunger, and thirst and were helplessly marooned without light and power. This might not have been too bad, when after an hour or two your telephone and electric-power service had been restored. But what would happen if such conditions were not the result of a thunderstorm and could not be repaired for days, or maybe weeks, or even not at all? Without outside help you definitely would lose your battle of survival.



Development of the A-bomb and H-bomb leaves the defender with little time to develop and apply defensive methods. The diagram shows how the rapidly increasing impact of modern weapons virtually has eliminated the all-important time factor of defense.

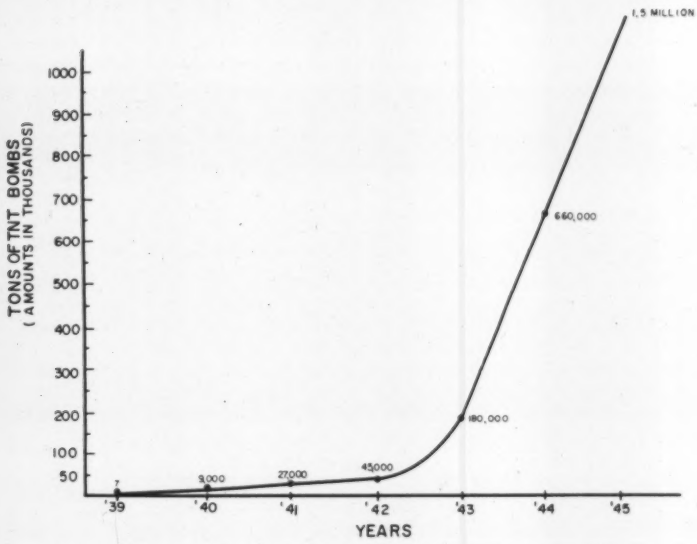


A comparison of the impact of World War II bombs with today's nuclear weapons well illustrates the increasing vulnerability of industrial targets to enemy attack

The conclusion so far is that in a possible future war the odds are against the defender, and this seems to be amplified when the defending nation is more dependent upon modern means of civilized life.

In presenting this subject, I have only the very doubtful "asset" of having lived through several hundred air raids during World War II as a private citizen as well as a technical leader of a German aircraft-engine factory. I have had, therefore, firsthand experience in the struggle for survival at that time, familywise and industrywise, and perhaps am in a position to know some of the problems involved. Today's problem of survival would be multiplied many times.

A large portion of industry and, more important, the broad population of our country remain entirely passive toward this vital problem. We simply have not yet realized that we are already in the middle of a battle for survival.



Tons of TNT dropped on German territory—not accumulative

A Program of Action

The "Industry Under Enemy Attack" problem and required action boil down to this:

Stock-Pile Weapons and Supplies. Weapons for either attack or defense which we do not have at the time of an enemy attack we should not expect to get after the attack. Practically every item that might be absolutely essential for either defense or counterattack must be kept stock-piled in sufficient quantities, and constantly reviewed and adjusted in order not to become obsolete. The storage areas for such stock piles should consist of heavily protected self-supporting underground shelters.

Emergency Transportation and Storage. It seems to be wise to extend this stock-pile idea to such essentials as emergency transportation, food, and medical supplies. This stock pile should be at least sufficient for emergencies of one week. Every larger city or community or essential industry should have such a protected emergency storage to last until help from some outside source reasonably can be expected.

Family Action. Additionally, each family should have its own small emergency supply consisting of such things as water, food, fuel, medical first-aid equipment, tools, matches, flashlight, and a small emergency power supply or batteries. The latter might become of tremendous importance as a power supply for at least a one-way wireless communication system. As a matter of fact, I would go even so far as to suggest a law that would require new housing to have a built-in shelter large enough for the inhabitants and the storage of emergency supplies and equipment, as well as independent means of running a two-way communication system. For already existing housing the law should set a dead line to have such facilities and equipment installed. With proper planning these facilities should not be too expensive. As you can well see, it is the protection of the people and the means for it which I believe need much more concern than keeping industry as a whole going. Industry could really be protected only if it were dug in pretty deeply underground, and because of the tremendous expense for such an establishment, such an approach would have to be limited to only the absolutely essential parts of industry.

Restoring Industry. Obviously though, we cannot depend on the stock-piling idea alone. The ways and means of aggression and attack are, as I said, manifold. The timing might be tomorrow, next year, five years, or never. The means for protection and defense by necessity also have to be manifold. We might not have stock-piling or might not have it completed. The problem to restore parts of industry and get them going can, therefore, still become a crucial one.

There are many schemes which can be followed. None probably is regarded as ideal for every industry or company, but a basic one may be helpful for specialized planning. Most important of all is that management be aware of the imminent importance of the problem and

be willing to establish an organization which insures rather than produces.

The Koppers' Plan

According to an article in *Steel*, July 5, 1954, the Koppers Company has the following plan of action for recovery from an enemy air attack, which is as good as any I can think of. Its three general phases consist of training, planning, and procurement.

The "training phase" provides for:

1 Training auxiliary personnel for security duty.
2 Training employees in handling emergencies.
3 Training key personnel in leading emergency troops.
4 Establishing emergency shutdown and restoration procedures.
5 Establishing contact with the local civil-defense agency.
6 Initiating a shelter program using existing facilities.
7 Beginning a program of safeguarding corporate interests, including microfilming records, designating emergency headquarters, and making management and other succession plans.

The "planning phase" consists of planning for:

1 Increased security personnel.
2 Safeguarding critical equipment and areas.
3 Additional fire protection and water storage.
4 Alternative means of communication, specifically a two-way communication system.
5 Stock-piling replacements and material, food, and medical supplies.
6 Floodlighting critical plant areas.
7 Insuring adequate utilities service.
8 Emergency power supply.

The "procurement phase" includes constructing:

1 Auxiliary water and power generating systems.
2 Protection for critical equipment and supplies.
3 Shelters for employees.

Such a plan, when sufficiently organized and implemented, could be of tremendous help in putting an industrial concern back into at least partial production.

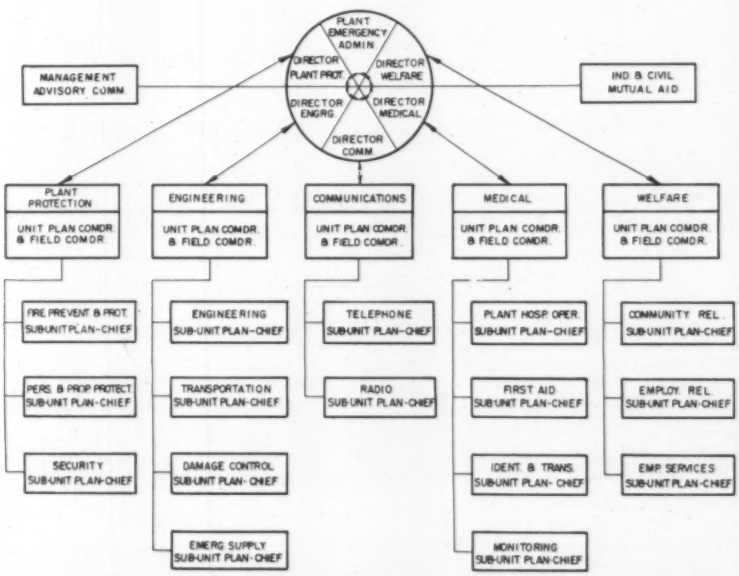
Another Approach

An emergency organization is currently in operation at the plant with which the author is connected. Its main branches consist of plant protection, engineering, communication, medical, welfare, industrial, and civil mutual aid. In order to be prepared for emergencies of all kinds, every position is covered with two or more incumbents.

Briefly, here are some of the most important functions of our organization:

In so far as engineering is concerned it is vital that this group have all the technical knowledge and the authoritative and physical means either to maintain, shut down, or rebuild the plant operation. Emphasis has to be placed on the ability to rebuild. It has to be realized that in the state of a real emergency no effort can or should be spent to get inessential industries going or rebuilt again. People and remaining equipment concerns can provide sufficient manpower and other resources to rebuild essential industries.

In so far as welfare is concerned I have already stressed the point that people are more important than anything else. Industries which have not established extremely good employee relations and ways and means to care for and protect their personnel, to communicate with them, and to help them to commute after an attack will suffer a possibly irreparable damage. We have to realize that in such instances nearly everyone is affected personally in one way or another. Absenteeism from work in such cases will naturally be extremely high. If we



Emergency attack plan as established by the Evendale Plant of the General Electric Company's Aircraft Gas Turbine Division

Aftermath of bombing raids in World War II—In contrast an H-bomb attack would not leave a wall standing

cannot keep our employees coming back to work to help rebuild what has been damaged, and to do so largely disregarding their own troubles, we will not survive.

Referring to industrial and civil mutual aid, may I reiterate that after the blow everyone is on his own for an indefinite but comparatively short period of time. To guarantee that after the initial period of time an organized co-ordinated effort for rescue and restoration follows immediately, carefully prepared mutual-aid plans between neighboring industries and between industry and communities have to be established and organized. The people involved have to be trained to the extent that the operation runs more or less like clockwork.

Rules for Survival

In conclusion, the two most important factors involved in insuring the survival of industry under future enemy attack are:

Protect your people and teach them to protect themselves.

Protect essential goods and services and have them ready by means of stockpiling them.

To really protect key or vital industries they would have to be deep underground with all the supporting population, supplies, and essential goods and services being underground with them. Of course, the tremendous costs for such a project makes this impossible for more than the most critical industries.

The order of magnitude of effort in manpower, money, sweat, and grief which we spend or would have to spend to activate such or similar plans of passive defense, in addition to the plans for active defense, already consumes a large percentage of effort of our lives. To me it appears to be a very ineffective way of guaranteeing our lives as well as the lives of our descendants.

With all the progress that we claim to make in science and other achievements, can we really not apply the very same effort in some other more useful and effective way to prevent mankind from being annihilated?

Perhaps the answer to this question will some day be provided. However, until a true means for preventing global war can be devised, the most logical answer seems to be to take every action necessary to prevent the shortest war in history, if it should come, from spelling total defeat for our nation.

References

"The Need for Industrial Dispersal," materials prepared for the Joint Committee on the Economic Report by the Committee Staff, August 1, 1951, United States Government Printing Office, Washington, D. C., 82nd Congress, 1st Session, Document No. 55.

"Hiroshima Diary," by Michihiko Hachiya, *Look Magazine*, vol. 19, August 9, 1955, p. 19.

"Damage Control in Wartime," by M. C. Neuhoff, Studies in Business Policy No. 53, National Industrial Conference Board Inc., 247 Park Avenue, New York 17, N. Y., 1951 copyright.

"Mobilizing for Atomic War," by B. R. M. Ballenger, Conference Board Reports, Studies in Business Policy, No. 46—National Industrial Conference Board, Inc., 247 Park Avenue, New York 17, N. Y., 1950 copyright.

"Job for Management," U. S. Dept. of Commerce Business, Defense Service Administration and Washington U. S. Government Printing Office, Washington 25, D. C., 1954, O-323292.

"Emergency and Disaster Planning for Chemical and Allied Industries," United States Dept. of Commerce, U. S. Government Printing Office, Washington 25, D. C., November, 1953.

"Hamilton County Plant Protection—Civil Defense Organization Proposal," by James R. Clark, Chairman, Executive Committee—Cincinnati-Hamilton County Civil Defense Organization.

"Evendale Industrial Civil Defense Mutual Aid Organization," General Electric Company, Evendale Plant Industrial Emergency Plan, August 1954.

"Bombings—Plants Were Still There," *Iron Age* 170, October 16, 1952, p. 44.

Hamilton County Plant Protection—Civil Defense Organization Proposal for the Protection of Industrial Production.

"American Industry and the Industrial Defense Program," United States Dept. of Commerce, Business & Defense Services Administration, Washington 25, D. C.

"Chemical Plant Vulnerability (Damage Expected to Result From Atomic Bomb Exploding Above Ground)," *Chemical Week*, vol. 74, January 2, 1954, p. 16.

"The Koppers Company Plan for Action," *Steel*, vol. 135, July 5, 1954, p. 34.

"Impact of Air Attack In World War II—Selected Data for Civil Defense Planning," vol. I, division II, parts I and II—"Economic Effects—Germany." Vol. II, division II, part III—"Economic Effects, Japan"—Stanford Research Institute.

Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Acting Editor*

Oceanographic Research

NEW YORK UNIVERSITY commissioned *Action*, a sleek, two-masted, 65-ft racing schooner for oceanographic research on Aug. 22, 1956, at the City Island Yacht Club, New York, N.Y.

The boat will be used to study scientific problems ranging from the effect of tiny ocean waves on radar to long-range weather forecasting.

During the informal commissioning a violet and white NYU pennant was rung up the mast of the *Action* by P. Gerhard Neumann, professor of oceanography in the university's College of Engineering.

The *Action*, built in 1930 for the Bermuda Cup Race, but never entered, was designed by John G. Alden. She has a 90-hp Universal engine, five working sails, and her gross tonnage is 28. Her cruising speed is seven knots. Except for a period during World War II, when the Navy used her to patrol New England coastal waters, she has been a pleasure craft.

Larger vessels, used principally for deep-sea research, Dr. Neumann explained, are too expensive and usually not suited to the precise air-sea boundary research conducted at NYU.

He pointed out that the *Action's* construction permits her to cruise in a wide radius and makes her sufficiently stable while scientific observations are being made. This is crucial, he added, in accurately measuring wave energy and wind speeds at the same time. The wind-wave relationship is fundamental in maritime meteorological research.

NYU Engineering Research Division will first use the ship in a study of air-sea boundary processes. Scientists will measure the energy and frequency of tiny ocean waves (less than 2 in. high) to find out how they reflect radar signals and reduce radar's usefulness in navigation. Also under consideration are plans to study tides and currents in the metropolitan New York area relating to water pollution, bathing areas, the erosion of coastal areas, and the shellfish industry.

Among the studies under way or planned for the *Action* are the following:

1 Air-sea boundary processes, including the exchange of energy between the atmosphere and the ocean, and oceanic effects on long-range weather forecasting.

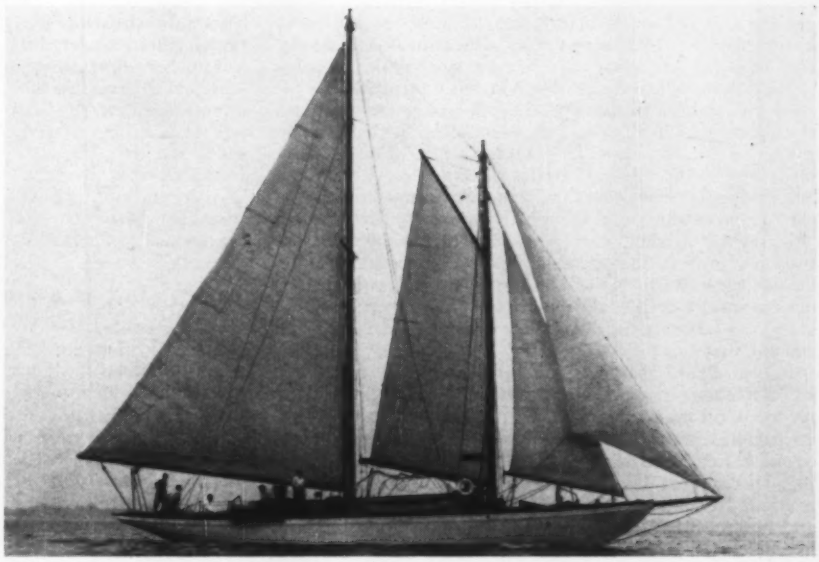
2 Solar radiation, including the question of how much of the sun's energy penetrates the sea and how much is reflected. Knowledge of the water-air "heat exchange" should improve weather forecasting, according to meteorologists.

3 Evaporation of water surfaces under different weather and sea conditions.

4 Exchange of water masses between the open sea and landlocked water bodies. This study would give—besides the basic hydrographic information—clues to the solution of such problems as water pollution and the washing away of certain mainland and island coasts by tides and other currents.

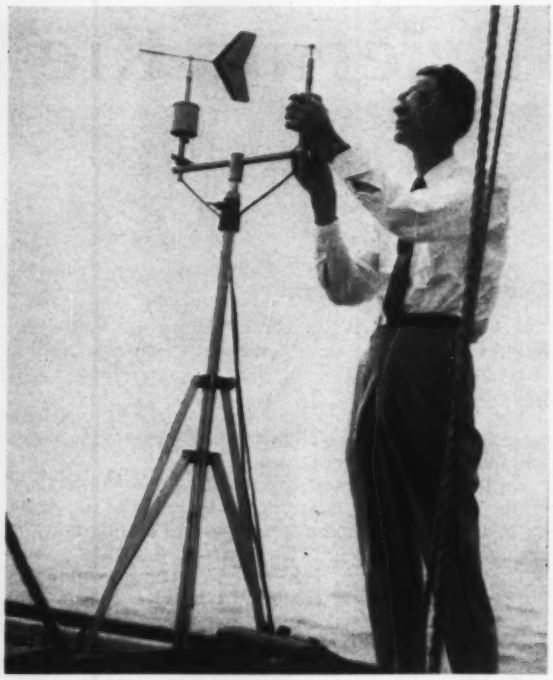
5 Offshore summer land-sea breezes, which cause an upwelling of cold water from lower layers of the ocean, to obtain more information about water-temperature forecasting for bathing and fishing purposes.

Primarily a research ship, the *Action* will be used at times as a laboratory for oceanography students. "Although oceanography is a precise and highly mathemati-



Action, 65-ft schooner recently purchased by New York University, and to be used for research in oceanography, was commissioned at informal ceremonies August 22

Aboard the new New York University oceanographic research schooner *Action* a research assistant prepares to lower a bathythermograph over the side. The heavy, bomblike instrument reads the temperature and pressure of the sea at various levels. A smoked-glass slide inserted in the instrument keeps a permanent record. Other components are an aneroid barometer and a special thermometer. As they record temperature and pressure, they move a stylus, which scratches the record on the slide.



James E. Miller, professor of meteorology, adjusts a very sensitive cup anemometer aboard the New York University research boat *Action*. The wind-measuring instrument has a very low coefficient of friction and therefore can measure variations in wind speed under two miles an hour. Such precise measurement is important to research on the effect of sea-surface conditions on weather. NYU is using its new boat to study the role of the interplay between ocean and atmosphere on long-range forecasting.

cal science," Dr. Neumann says, "the student should get the feel and smell of the sea. Classroom and book knowledge of hydrodynamics, differential equations, and the like are essential, but so is the ability of a scientific student to make observations on his own."

Dr. Neumann will share the direction of research aboard the *Action* with Willard J. Pierson, also an NYU oceanographer. Dr. Pierson has worked on the development of a method of forecasting the complex pattern and behavior of ocean waves, which has been incorporated into a practical manual for naval officers.

Harry D. Rogers, the captain of the *Action*, will be the only professional crew member. Dr. Neumann and Dr. Pierson with NYU students of meteorology and oceanography will make up the rest of the crew of the sea-going laboratory. The *Action* will sail in inland and coastal waters.

Recent NYU oceanographic research has developed an electronic instrument that analyzes ocean waves recorded on magnetic tape, which is of value in beach-erosion research, harbor protection, and other aspects of coastal engineering.

A theory was developed which may well bring forth a marked change in the design of merchant, passenger, and naval ships in the next five years that involves the first scientific approach for describing the actual motions of ships in waves. The theory was presented in a paper, "On the Motion of Ships in Confused Seas," by Dr. Pierson and Manley St. Denis, noted naval architect. The new theories are now being applied in towing tanks where model ships are tested before construction.

Another investigation under way concerns large-scale oceanic circulation and its relation to atmospheric circulation, the so-called "tides of air." This study is one of a group of projects intended to improve long-range weather forecasting by establishing precisely the interaction between the ocean and the atmosphere. This interaction is also important in immediate, specific weather situations; for example, on the relation of sea-surface temperatures to hurricane development.

Air-Cooled V-4 Engine

An air-cooled V-4 engine has been built by American Motors Corporation, Detroit, Mich., with an unprecedented number of aluminum parts.

Aluminum Company of America's sales development division co-operated in the design of the engine, and furnished major structural parts to the special products division of AMC.

The engine, weighing but 200 lb, carries 70 lb of finished aluminum and develops 62 hp.

Cylinders are individually die-cast of aluminum alloy, and the bores are chrome-plated for durability. Assembly of the required number of individual cylinders to an aluminum die-cast crankcase provides the varying sizes

of power packages, in either V or horizontally opposed configuration, and with maximum interchangeability of parts. Cylinder heads, cylinder covers, and timing gear housings also have been designed for aluminum diecastings. The technique reduces machining time, weight, and costs.

George Romney, president of American Motors Corporation, said that the new engine could have three important applications—to power air-borne military vehicles, for use in a small private passenger or commercial car, and for such stationary equipment as pumps and generators. All applications require compactness, light weight, economy of operation, and ease of maintenance.

The new engine is especially suited for powering air-borne military vehicles capable of carrying four men with complete battle gear, or two men with full equipment and a two-way radio installation. A prototype installed in an experimental lightweight vehicle has undergone extensive military field tests.

The AMC V-4 engine has a displacement of 108 cu in. and compression ratio of 7.5 to 1. It has a bore and stroke of 3.25 in. × 3.25 in. and utilizes a valve-in-head arrangement. Length, width, and height are approximately 2 ft each.

Rolling Classroom

ABOARD the "Techmobile," a 35-ft rolling classroom which is touring the United States and Canada to display and demonstrate proper application of wire screw-thread inserts made by the Heli-Coil Corporation, Danbury, Conn., the screw-lock (mid-grip) insert was demonstrated recently. This insert, newest addition to the Heli-Coil line of inserts, eliminates lock nuts and lock wiring.

The screw-lock insert is assembled in the same manner as regular Heli-Coil screw-thread inserts and offers all the thread protection of the regular inserts, in addition to locking screws, set screws, and bolts against vibration. Of simple, one-piece design, the insert puts the locking effect inside the tapped hole, eliminating the cost of lock nuts and lock wiring, and providing a design free of such protruding parts.

Screws and bolts are held securely against loosening by one or more grip coils near the center of the screw-lock insert. These coils approximate a polygon in shape instead of being circular. As the screw is run through the insert, the grip coils are forced to conform to the thread circle. The chords of the grip coils maintain a strong, springlike pressure on the screw, giving a locking effect which is not diminished through repeated disassemblies. The locked screw may be disassembled readily by applying breakaway torque approximately the same as assembly torque.

Like standard Heli-Coil inserts, the screw-lock inserts are made from 18–8 (AMS 7245B) stainless-steel wire having an ultimate tensile strength of about 200,000 psi. They armor tapped holes in all materials—light metals, plastics, copper, and wood, as well as iron and steel—against wear, stripping, galling, seizing, and corrosion; the screw or stud always fails first under excessive load. They increase thread life and strength and, because they require only standard boss diameter or wall thickness, permit savings in boss material, weight, and space. They may be incorporated easily into an otherwise frozen design.

On the international tour of the Techmobile, visits to demonstrate the correct design and installation of wire-thread inserts will be made upon invitation from present users of inserts as well as prospective users. The schedule of the Techmobile will permit demonstrations to be repeated over several days at a single plant employing large numbers of design engineers such as in the aircraft and automotive industries so that all engineers interested will be able to see the demonstration and discuss specific problems with the Heli-Coil representative.

The Techmobile is air conditioned and has its own power-generating plant to operate power tools, lights, and visual aids. There is seating capacity in the Techmobile for groups of 20 persons.

A demonstrator illustrates the use of Heli-Coil screw-thread inserts aboard the Techmobile rolling classroom now touring the United States and Canada

Coke-Processing Plant

A LARGE-SCALE operation to convert Gilsonite to coke and high-octane gasoline is under construction by the American Gilsonite Company of Salt Lake City, Utah. The project involves three phases: (1) new "wet" mining techniques at Bonanza, Utah; (2) one of the world's longest pipelines for transporting a solid material; and (3) a processing plant near Grand Junction, Col.

The raw material, Gilsonite, is a solid black hydrocarbon with a high resin content. It has been used largely in making asphalt floor tile, storage battery boxes, inks, paints, varnishes, and as an insulation for hot underground pipes. Extensive pilot-plant experiments have indicated that commercial manufacture can convert Gilsonite into a high-grade electrode coke of exceptional purity, which would find a ready market in the manufacture of aluminum and in the specialty carbon fields. Tests also indicated that the coproduct gasoline is of excellent quality, with very high octane ratings capable of meeting anticipated future requirements for many years.

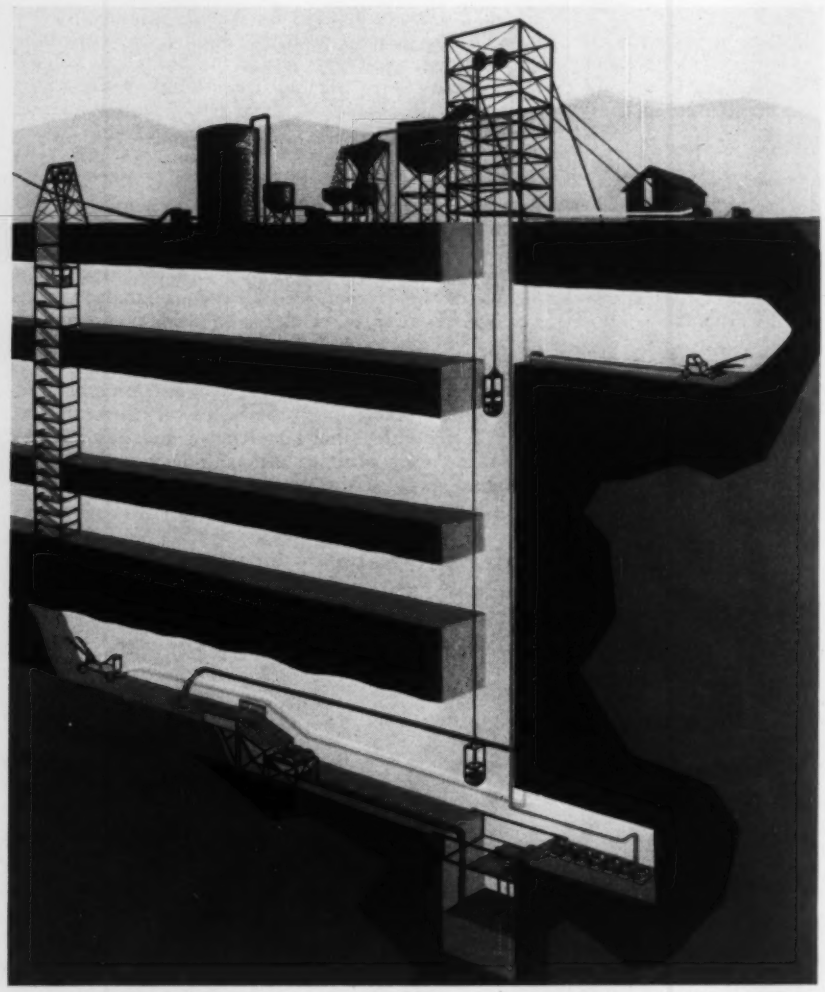
Gilsonite occurs in nearly vertical fissures that vary in depth from 100 ft to more than 1500 ft. The fissures vary from a few inches up to 22 ft in width. Ore for the manufacture of coke and gasoline will be extracted from veins that are greater than 6 ft in width.

One of the original features of the operation is the introduction of new "wet" mining methods developed by the company over the past four years. Cutting, breaking, and transporting the Gilsonite by hydraulic means will eliminate the explosion hazards from Gilsonite dust in confined areas. Until now, mining has been accomplished by mechanical and hand-picking methods.

The company is sinking vertical shafts between the rock walls which enclose the Gilsonite fissure. Drifts will be cut into the Gilsonite in both directions between the shafts. They will be driven, starting at a depth of 50 ft and continuing at 200 to 300-ft vertical intervals, on a rising grade of about 2 $^1/_2$ deg.

These drifts will be cut in two ways, depending on the nature of the ore in the vein: By jets of water under a pressure of about 2000 psi, and by a toothed, rotary hydromechanical drill. A low-pressure stream of water will wash the broken Gilsonite down a "v"-notch cut in the floor of the drift to the shaft. The mechanical drills cut a swath through the ore; a stream of water issuing from the teeth on the drill keeps the ore wet and washes it into the v-notch.

At the bottom of the shaft, the water and Gilsonite under $^3/_4$ in. in size will be separated from the few larger chunks of ore. The latter is sifted to the surface in conventional buckets while the Gilsonite-water slurry containing the finer material is pumped to the surface. When the initial drifts are completed, the "jumbos" will be returned to the shaft, lowered about 10 ft, and put to work cutting another drift.



Cross-section of a Gilsonite vein showing how the new hydraulic mining methods, developed by American Gilsonite Company, will be applied. A vertical shaft is first sunk, and slightly sloping drifts are cut at right angles to it. Hydraulic mining methods will be used exclusively, thus eliminating explosion hazards from Gilsonite dust. The cut ore is washed to the bottom of the shaft and raised to the surface in buckets. Two new types of ore cutters are used.

The Gilsonite-water slurry will be pumped through a 6-in.-diam pipeline from the mines at Bonanza, Utah, over two suspension bridges, across an 8500-ft mountain pass, and into the plant at Gilsonite, Col., near Grand Junction. Some of the most rugged, uninhabited mountain terrain in the country will be traversed. To prevent the solid material from sliding to the low places and plugging the line, the grade on the pipeline will be kept to a flat slope. The slurry will be kept moving through the line at relatively high velocities so that the solid material will not settle out, and the line is so designed that it will be very difficult to shut it down accidentally.

The pipeline will be buried beneath the frost line. The concentration of the Gilsonite slurry will range between 20 and 60 per cent, with the water content ranging from 80 to 40 per cent, respectively.

Gilsonite will flow into the processing plant at the rate of 630 tons per day; output will be 250 tons per day of coke, 1300 bbl per day of gasoline, and 300 bbl per day of fuel oil. The pumping units will maintain a pressure of 2200 psi and a flow rate ranging from 200 to 500 gpm at 570 hp. The pipeline itself will hold some 1,000,000 gal of water.

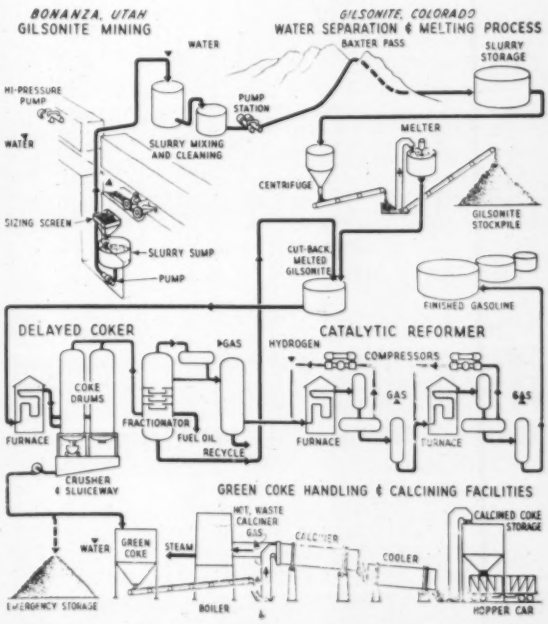
When the Gilsonite-water slurry reaches the processing plant, it will go through dewatering and melting processes to produce a liquid feed for the subsequent operations. This will be the first coking plant to perform the complete coking operation at a single site, for American Gilsonite will both produce and calcine the coke here.

The Gilsonite is separated from the pipeline water by injecting a small amount of oil into the pipeline upstream from its discharge point at the refinery. Gilsonite has an affinity for oil which causes the small particles to agglomerate and, since Gilsonite is hydrophobic, it can be separated from the water by straightforward filtering or centrifuging operations.

The dried ore is melted and heated to 450 F and charged to the delayed coker. The feed is pumped into a direct-fired horizontal updraft heater operating at 910 F. The output from this heater discharges into a coke drum.

Here the liquid separates from the vapor; coke is formed and precipitates out of the liquid. Coke is continually forming. When the coke reaches a level within a predetermined distance from the top of the coke drum, the drum is taken off stream, and the outlet from the direct-fired heater is switched into a clean drum and the coking process continues.

The formation of the coke in the drum consumes part of the output from the heater. The remaining part, consisting of vapors and gas, passes through the drum and into the fractionator. Here various vapors are separated and condensed to form liquids. Some become the recycle streams. One liquid, a gas oil fraction, is withdrawn and charged to a thermal cracking heater furnace. In this heater, the charge is heated to, and held at, a cracking temperature of 985 F. After cracking, both the temperature and pressure are reduced, and the vapor-liquid mixture re-enters the fractionating column where it is separated into gas, gasoline, recycle stock, and cracked tar. Since the tar contains coke-forming fractions which are part of the over-all coke production when recycled through the delayed-coking section, the only products from the fractionator are gas and gasoline.



Flow diagram of the Gilsonite coke processing project

The final conversion to finished gasoline takes place in the catalytic reformer, which consists of three sections. The first section generates hydrogen which is pumped into the raw gasoline being supplied from the delayed coker to the second section of the catalytic reformer. The hydrogen combines with the nitrogen compounds in the raw gasoline, converting them to ammonia which can easily be removed as a gas from the gasoline. The raw material is converted into finished gasoline in the third section of the reformer in the presence of a catalyst.

Water and volatile and combustible materials are removed from the green coke in the calciner. Green coke is cured by driving these materials out by heat. This is done in a sloping, rotating kiln 10 ft in diam and 180 ft long. As the kiln turns at about one rpm, the green coke is fed into the upper end and slowly gravitates to the lower end. By the time the coke reaches the end, the moisture and volatile and combustible materials have been removed by heat. The hot, calcined coke passes through a cooler which is another rotating drum 8 ft in diam and 80 ft long which turns at about 3 rpm.

The final products of the refinery are, by weight, 50 per cent green coke, 35 per cent gasoline, and 15 per cent 1400 Btu gas which will be used as plant fuel. The processing plant is expected to be completed in the late spring of 1957.

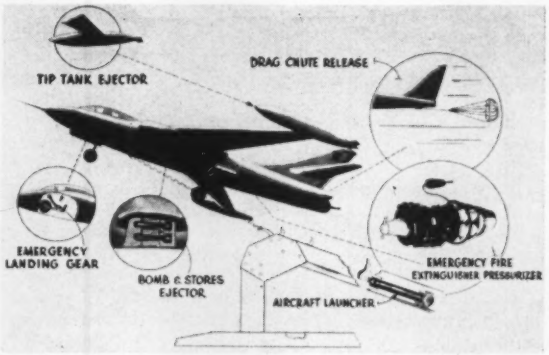
Liquid Chemical Lock Nut

A METHOD whereby ordinary threaded fasteners can be locked using a chemical sealant has been announced by the American Sealants Company of Hartford, Conn. Trademarked Loctite (R), this new liquid, which locks like kerosene, hardens automatically in the joints between metal parts, sealing the joints pressure-tight

and bonding the parts together with a tough heat and oil-resistant plastic.

Machinery assembled with ordinary nuts and bolts which have been wetted by tumbling briefly with Loctite (R) sealant will not loosen under the most severe conditions of vibration because the mating threads become filled with hardened plastic. Although providing a superior lock to mechanical-type lock-fasteners, Loctite (R) treated nuts and bolts can be easily removed with ordinary tools. The problem of set screws which loosen can be effectively eliminated by treating them with Loctite (R) sealant. Loctite (R) sealant seals and bonds sleeve joints between metal parts without the use of corrosive fluxes and without danger of tarnishing polished surfaces with heat.

Because it is a penetrating liquid which hardens automatically in pores or joints in metal parts, it is particularly well suited to sealing porous welds and leaky threads in pipelines and process equipment.



Proposed aircraft applications for cartridge-actuated devices involve many functions in addition to assuring safe escape of plane personnel. Studies of potential applications are shown.

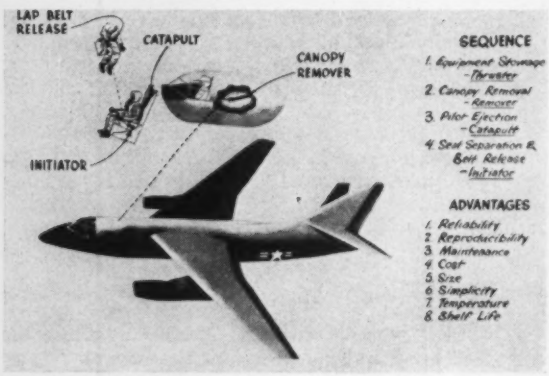
Cartridge-Actuated Devices

A DEVELOPMENT program for cartridge-actuated devices (CAD items) has been carried out at the Pitman-Dunn Laboratories of Frankford Arsenal for the Ordnance Corps, sponsored by the Air Force. CAD items are the operating components of escape systems. The energy for operating these systems is derived from propellant charges, somewhat like shotgun shells.

Various devices have been designed, fabricated, and presented as standardized items for use on aircraft. With the growing acceptance and need for these items, other organizations, such as the American Machine & Foundry Company, have been given assignments for development of cartridge-actuated devices.

The mechanics research department of AMF has been active in research and development programs for CAD used on several of the modern fighter and bomber aircraft.

This AMF Chicago facility, with its own Ballistic Test Station at Colorado Springs, has made significant contributions to the various ejection devices used on various aircraft: (1) catapults for ejecting personnel from aircraft; (2) canopy removers which jettison the aircraft canopy; (3) initiators which serve as a kind of pneumatic switch for operating other CAD items; and (4) thrusters which are used to position the pilot's seat just prior to ejection, stowing column controls, and unlocking the canopy.



Simple escape system for aircraft personnel is composed of several cartridge-actuated devices being developed at American Machine & Foundry Company's Mechanics Research Department

These devices have gained widespread application for the following reasons:

(*a*) Performance is reliable and reproducible; (*b*) the energy is readily available; (*c*) little maintenance is required; (*d*) cost is low; (*e*) component design is simple; (*f*) the power plant is contained in a relatively small package; (*g*) performance is relatively temperature insensitive; and (*h*) no significant deterioration occurs during long periods of storage.

In the early stages of the CAD development program, attention was centered on installations for fighter aircraft only. Later the field of application was enlarged to include bomber aircraft. This naturally increased system complexity because of the requirement for multiple operation such as: (*a*) Escape of several crew members instead of just one; (*b*) system initiation from several points or by any of several crew members; (*c*) positioning of the several crew members prior to an emergency abandonment; and (*d*) stowage of control column, bomb sight, and other equipment away from the ejection path.

This compounding of operations pointed out the need for automatic sequential functioning of system components and made it necessary only to start the process. Once the system is actuated, there would be a continuous "get-ready" process up to seat ejection.

In a simple escape system an initiator which may be located on the arm rest of the pilot's seat is triggered manually. Gas generated in the device passes through a length of tube to operate the firing mechanism of a canopy remover. By operation of a second initiator, connected in a similar manner to a catapult, the pilot seat is ejected from the disabled aircraft. Concurrently, a delay initiator is triggered 2 sec later. This actuates the pilot's lap-belt release to permit him to fall free of the seat and descend by parachute. Other devices such as thrusters are used in more complex systems where it is mandatory to position the pilot seat with respect to the escape hatch and stow the control column, bomb sight, or other equipment prior to the ejection cycle.

Plastic-Coated Steel Sheet

PLASTIC-COATED steel sheets, that combine the structural strength of steel with the rich decorative effects of vinyl plastic in an almost limitless variety of colors and textures, are now in experimental production at U. S. Steel's Irvin Works in Dravosburg, near Pittsburgh, Pa.

Cold-reduced sheets are coated with liquid plastic to produce a durable, appealing, tough-surfaced sheet. It promises new decorative effects and long service in such equipment as refrigerators, radio and TV cabinets, wall panels, automotive bodies and trim, stove and heater parts, railroad coach, club, and sleeping-car interiors, office, and home furniture.

During manufacture, the steel is surface treated to improve its bonding qualities, a specially compounded adhesive is applied to the top surface and then cured by heating.

After air cooling, the steel enters a coating chamber where the thermo-responsive vinyl plastic is applied to the adhesive-coated surface. Again, heat is applied to solidify the plastic. Prior to cooling, the vinyl coating is embossed to obtain the desired design or texture. The finished product is stacked by a magnetic piler.

The coating of this new material is said to have excellent abrasion resistance and good electrical-resistance properties. It is unaffected by humidity and many chemicals.

The coating also produces sound-deadening effects similar to that obtained by "muffle coating" automobile bodies and will have value in acoustical design.

Supplied in any standard color, the new product can be utilized for manufacturing many parts which heretofore required protective or decorative finishing after fabrication. Elimination of the need for such post-fabrication treatment, coupled with the unique properties of the new coated sheet, will result in lower production costs, together with superior wearing qualities and decorative effects.

At present, due to the developmental nature of the operation, no definite annual production capacities have been established. The pilot-line facilities at the Irvin Works will produce 18 to 28-gage sheets 24 to 52 in. wide. The semicommercial product is being offered for sale on a developmental basis.

Leaded Steel

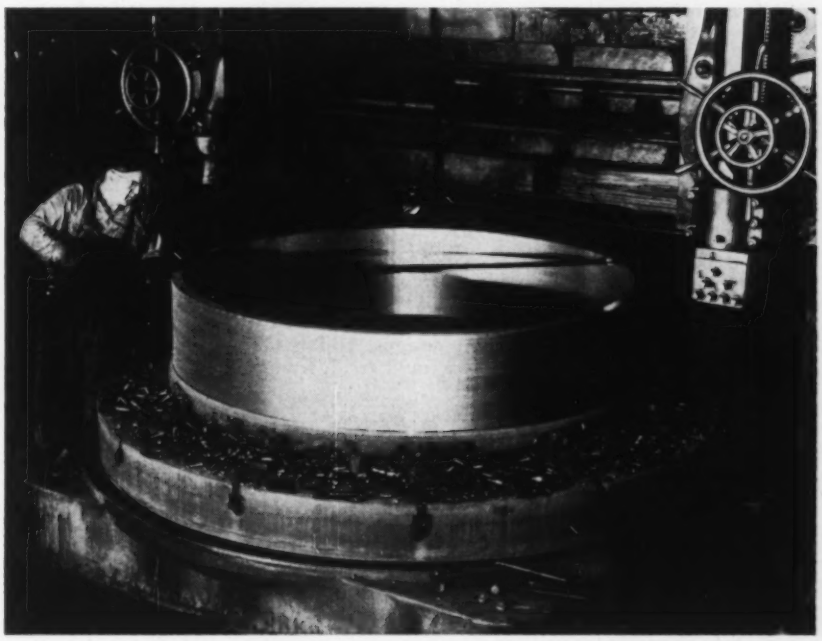
A NEW leaded steel that has resulted in impressive decreases in machining tool costs has been developed by ALCO Products, Inc.

Called Hi-Qua-Led Steel, the leaded steel is produced at ALCO's Latrobe, Pa., plant in all steel grades in forged and rolled rings from 18 in. to 145 in. over-all diameter, and in ingots to 50,000 lb.

A variety of steel grades have been tested to date. In each case, physical properties of the steel remained basically unchanged, and the pattern of lead distribution unaffected by the grade of steel.

Outstanding machining characteristics are reported in several case histories developed by machining firms. Compared with carbon steel, savings in time ranging from 47 to 71 per cent were obtained during lathe operations; time in teeth cutting was trimmed as much as 50 per cent, and decreased tool wear ranged from 46 to 94 per cent. Increases in tool life when machining ALCO's leaded steel ran from 187 to 1600 per cent.

In each test, a pronounced improvement in machine finish was noted—and in some instances an acceptable finish was attained with a roughing tool. This factor is expected to lead to broad application of Hi-Qua-Led Steel wherever high-quality steel is specified and where machining costs are a consideration.



A machinist checks a large-diameter steel ring on a boring mill at the Latrobe, Pa., plant of ALCO Products, Inc. Forged and rolled rings such as this, in addition to ingots, are available in ALCO's new Hi-Qua-Led leaded steel, which tests have shown gives lead recoveries as high as 85 per cent and results in lower machining costs through savings in tool wear.

This combination of a 15-million-volt betatron and special stroboradiographic equipment has given engineers new "eyes" that not only see through steel but "stop" the action of a running engine and take x-ray pictures of its spinning, whirling inside parts. G-E developed the process for Detroit Arsenal.

Detroit Arsenal engineer Rudy Dunec studies one of the first stroboradiographs—x-ray photos taken through steel that stop action of a running engine. The stop action in the x-ray photo was obtained by superimposing several thousand short exposures synchronized with the pulses in the engine cycle.

Stroboradiography

MAKING motion pictures of the inside of an engine while it is running has been achieved recently by a General Electric Company-Detroit Arsenal engineering team.

The job involves taking x-ray pictures of the internal movements of the engine through its steel housing, and visually "stopping" with a camera their high-speed motion.

The new technique, called stroboradiography, could have a significant effect on engineering design. Slow-motion x-ray movies and still pictures of pistons, cams, and other moving parts have enabled engineers to scrutinize, for the first time, complete cycles of engine operation for faulty performance or wear.

The process gives designers their first glimpse inside a completed machine operating at normal speed under load conditions. Improved, lightweight designs, and perhaps important basic design changes could result from the x-ray motion studies.

G-E's General Engineering Laboratory in Schenectady, N. Y., developed the stroboradiography equipment, in co-operation with Detroit Arsenal and the General Electric X-Ray Department in Milwaukee, for use with its high-energy industrial x-ray betatron, operating at 5 million to 15 million volts.

Unlike conventional x-ray equipment, the betatron furnishes the surging radiation pulses—416 per sec—that have given engineers this "inside" view of a running machine.

Previously, single-shot exposures of moving objects had been made with low-energy equipment, but the quality of the radiographs suffered when the object was composed of heavy parts of varying thickness.

The new process involves taking thousands of short exposures accurately synchronized with the moving part. With an exposure time of 10 to 15 millionths of a second, it is possible to radiograph an engine turning at several thousand revolutions a minute.

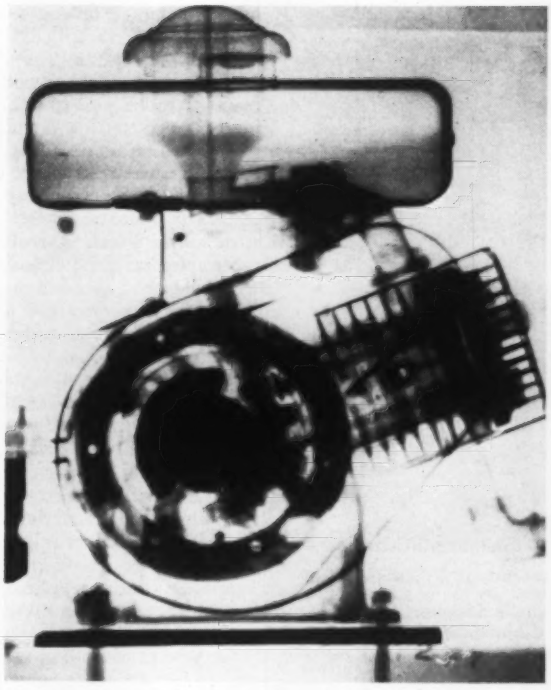
A synchronizing disk attached to the specimen engine signals the betatron and releases the surge of electrons that make the split-second x-ray exposure. Several thousand repetitions result in a strong image clear enough to be analyzed for operational data.

The superimpositions form the picture on special film that receives the filtered x rays after they have passed through the specimen.

To obtain slow-motion movies, x-ray "stills" are taken, for example, of various points in the travel of a piston, and the films spliced in sequence to show the complete cycle of the piston.

The walls of the test specimen, opaque to light, are partially transparent to the high-energy x radiation, thus enabling the betatron to "see" the internal working parts in their relationship to each other. The difference in the shape and density of the various parts enables the images to assume their proper perspectives in the stroboradiograph.

With this equipment, it is hoped that any individual shortcomings of a newly designed engine may be corrected by stroboradiographically examining the engine



The inner secrets of a running engine have been exposed in this pioneer x-ray picture. Engineers say the new tool will contribute to improved design and performance of engines. The x ray above was taken of a 2-hp 4-cycle gasoline engine at the Detroit Arsenal.

while it is running under load, thus showing up any components that might not be functioning correctly or efficiently.

Small Submarine Reactor Prototype

THE construction of a prototype reactor plant to power a small submarine has been approved by the Atomic Energy Commission and will be built at the Nuclear Engineering and Development Laboratory being established near Windsor, Conn., by Combustion Engineering, Inc., New York, N.Y.

Estimated cost of construction is about $10,000,000 and is scheduled to begin shortly.

Designated Project SIC, the reactor project is based on a requirement of the Department of Defense for the development of a nuclear-powered small submarine. The research and development contract for the reactor and associated systems was awarded in July, 1955, to Combustion Engineering, the third major AEC contractor to enter the naval-reactor-development program. The other two, Westinghouse Electric Corporation and General Electric Company, operate AEC laboratories under contracts with the Commission.

Land for the prototype reactor plant will be leased to the Commission by C-E for 40 years at a cost of $1.

According to Joseph V. Santry, Mem. ASME, chairman of the board of C-E, the submarine power plant will be installed in a steel replica of a hull having the exact size and dimensions of a portion of the submarine. All of the power equipment necessary for the propulsion of the submarine, including complete instrumentation for checking and testing every aspect of operation and performance, will be provided as on shipboard.

Navy submarine crews, he said, will be trained in the operation and maintenance of the power plant in order to become completely familiar with its operation.

Nuclear Briefs . . .

Atomic Submarine Engine Runs 66 Days

THE nation's first practical reactor power plant—the land-based prototype of the submarine *Nautilus* at the Commission's National Reactor Testing Station in Idaho—was routinely shut down on Aug. 8, 1956, at the end of what is believed to have been the longest full-power run ever completed by any type of propulsion plant—land, sea, or air, according to the U. S. Atomic Energy Commission.

On a single charge of uranium fuel (and using only part of that charge), the nuclear reactor located at the desert test facility operated at an average power of 100 per cent for more than 66 days and 66 nights. The test was designed to prove the reliability and stamina of pressurized water reactors for ship propulsion. The prototype of the reactor now in the *Nautilus* met the most demanding requirements that could be placed upon it.

At the end of the 1600-hr test, the reactor still had many hundreds of hours of full operation available and it has resumed operation at varying power levels to obtain engineering test data and to train the Navy's atomic sailors.

100,000-kw Nuclear Power Reactor

A conditional construction permit has been granted by the Atomic Energy Commission to the Power Reactor Development Company of Detroit, for the building of a 100,000-kw nuclear electric-power plant near Monroe, Mich.

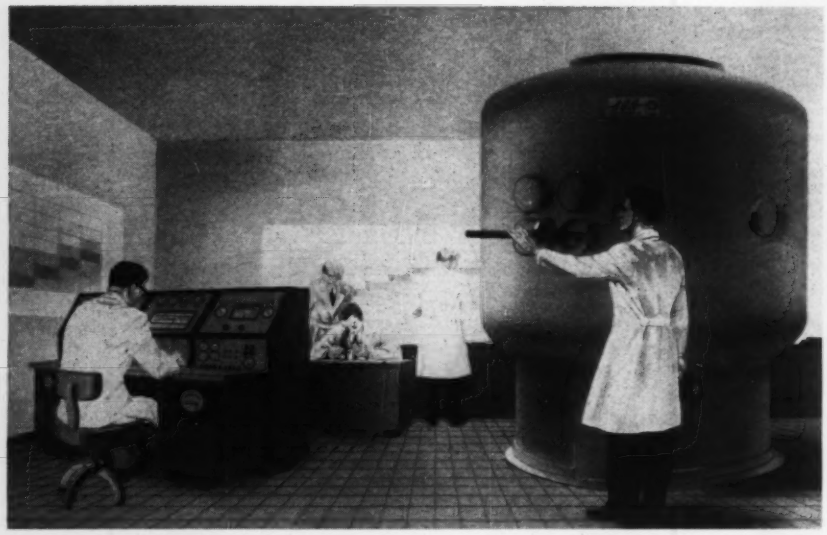
The power reactor, which will be of the fast-neutron-breeder type, will be constructed under the Commission's Power Demonstration Reactor Program initiated in January, 1955, to promote the development of commercial and industrial nuclear power.

Earliest completion date for the reactor specified in the construction permit is Dec. 15, 1959; the latest date, Dec. 15, 1960. The total cost of the reactor and related facilities is estimated by PRDC at $40,511,000.

Battelle Research Reactor

A license to operate a research reactor at a site about 15 miles west of Columbus, Ohio, has been issued by the Atomic Energy Commission to the Battelle Memorial Institute of Columbus, following completion of a preoperational inspection. The license is for a 10-year period dating from Aug. 5, 1955.

The reactor, constructed for Battelle by American Machine & Foundry Company on a 400-acre tract near West Jefferson, Ohio, is a modified "pool"-type facility designed to operate at 1000 kw, using contained uranium 235 as fuel. Battelle is licensed to possess and use 5.2 kg of contained U-235 in fuel-element assemblies



Aerojet-General Nucleonics of San Ramon, Calif., announced recently it is beginning the mass-production of small, portable, self-contained, nuclear reactors. By use of an ingenious method of core fabrication with radiation-stabilized polyethylene moderator, the reactor resembles a liquid homogeneous reactor but actually has a solid homogeneous core. The unique feature, however, is that the requirement for critical mass is approximately 600 grams of Uranium 235 of 20 per cent enrichment which is less than any known reactor. Of further significance is that the quadruply sealed solid core locks in the fission products, eliminating the problem of waste disposal and preventing the escape of radioactive contaminants. Under normal operating conditions the core life exceeds 300 years. Along with the normal reactor safety interlocks a thermal safety fuse built into the core enhances over-all reactor safety. Reactor safety and control rods are actuated from the reactor control console which also provides continuous reactor monitoring. Shown here is a typical installation of the self-contained AGN 201 nuclear reactor and control console in a research laboratory.

and 1.63 grams in neutron-measuring instruments incorporated in the reactor.

Besides its use in a wide variety of industrial research activities, the Battelle reactor is expected to furnish a source of neutrons for conducting exponential experiments on power reactor cores, work considered by the Institute to be important to the development of the nuclear-power industry.

Low-Power Reactor

The Atomic Energy Commission recently announced that the National Reactor Testing Station in Idaho has been selected as the site of the Argonne Low Power Reactor (ALPR). This is one of several prototype reactors which are being developed or are under consideration as power sources for remote military installations.

Construction of the plant, which will generate 200 kw of electric power, is scheduled to start late in 1956. Estimated cost is $1,225,000.

100 Milliwatt Research Reactor

A permit has been issued by the Atomic Energy Commission to Aerojet-General Nucleonics of Walnut Creek, Calif., for construction of a low-powered nuclear research reactor. The reactor will be located in San Ramon, Contra Costa County, Calif.

Aerojet-General Nucleonics has advised the Commission that it plans to construct the reactor, designated "AGN-201," as a prototype for additional reactors to be sold to colleges, universities, and other research institutions. It is expected that the reactor will have a variety of uses in educational, scientific, biological, agricultural, medical, and industrial fields.

Designed to operate at a power level of 100 milliwatts, the reactor is to be a compact, self-contained facility housed in a steel shell. It will use uranium enriched to 20 per cent in the isotope U-235 as fuel. The core will consist of uranium dioxide particles embedded in polyethylene serving as a moderator. Shielding of graphite, boron, lead, and water will surround the core.

Atomic-Reactor Sphere

The Chicago Bridge and Iron Company has been awarded a contract for construction of a huge steel sphere that will house the atomic reactor being built by General Electric Company for the Commonwealth Edison Company's Dresden nuclear power station near Chicago, Ill. This plant is the largest all-nuclear atomic power station yet scheduled. The sphere, to be 190 ft in diam, will be the second largest of its kind in the world.

Purpose of the new sphere will be to contain any radioactive products that could be released in the very remote chance of a reactor incident, coupled with the simultaneous failure of all other safety devices.

Housed in the sphere will be the new G-E dual-cycle boiling-water reactor and auxiliary equipment which will power the 180,000-kw nuclear power station for Commonwealth, 47 miles southwest of Chicago on the Illinois waterway.

Radiation Research

Mellon Institute, Pittsburgh, Pa., will soon initiate a major research effort in the field of peaceful atomic-energy applications, according to a recent announcement.

The Institute has established a new Department of Radiation Research to carry on the work, has employed an outstanding radiation chemist to head the department, and has purchased a 3-million-volt Van de Graaf particle accelerator as its initial radiation source.

The Institute's action stems from its conclusion, based on an extensive staff study, that ionizing radiation will find practical use in many segments of the sciences and industries. Research to be carried on in the new depart-

ment will embrace both basic studies on the nature of ionizing radiation and investigation of its practical applications in chemical processing, "cold" sterilization, and in other fields of use still unknown.

Modified Chromium Steel

DEVELOPMENT by the Navy of a useful 12 per cent chromium-steel modification without columbium is described in a report of research released for industry use through the Office of Technical Services, U. S. Department of Commerce.

The research was part of continuing investigations into replacement of austenitic steels by ferritic grades for high-stress, elevated-temperature applications. Modified 12 per cent chromium steels have received considerable attention, particularly for use in steam and gas turbines.

The report describes creep-rupture properties of the 12 per cent grade modified by additions of molybdenum, vanadium, columbium, titanium, and carbon. Tests were conducted at 1100 F and 1200 F for materials as-cast, cast and homogenized, forged and normalized, and forged, normalized, and tempered. Room-temperature properties also were determined.

Among other results reported, a modification containing 1.0 per cent molybdenum and 0.7 per cent vanadium showed creep-rupture properties which compared favorably with the best of the columbium-free alloys developed so far.

The report, PB 121226, "Investigation of Modified 12% Chromium Steels Intermediate Temperature Applications," by P. Shahinian and J. R. Lane, Naval Research Laboratory, April, 1956, may be ordered from OTS, U. S. Department of Commerce, Washington 25. It contains 26 pages, price 75 cents.

Steel Jetties

JETTY fields of steel are not only proving useful in protection against floods, but may also prove to be an important factor in taming wild rivers and making them stay in the channels where they belong, two hydraulic engineers of the U. S. Bureau of Reclamation told the Hydraulics Division of the American Society of Civil Engineers (ASCE) in its recent annual meeting at the University of Wisconsin, Madison, Wis.

How steel jetties are now being used successfully in several localities for the protection of structures, levees, and banks of rivers from the ravages of floodwater was described by Enos J. Carlson and Phillip F. Enger, both hydraulic engineers with the U. S. Bureau of Reclamation at Denver, Colo.

They told not only of the development of the use of steel jacks and jetties in flood control work, but also of results to date in the use of steel on the experimental channelization of the Rio Grande River in the Casa Colorado area of the middle Rio Grande Valley.

It was pointed out in the paper that steel jetties have now been used with considerable success in flood control by the Santa Fe Railroad, the Kansas State highway department, and the Albuquerque, N. Mex., district of the U. S. Corps of Engineers.

Explaining the steel-jetty system of flood control, the authors said that the single structural unit of the system is called a jack, and a number of jacks connected by heavy wire make up a jetty.

The usual layout of a steel-jetty system, they reported, involves two types of lines—one running parallel to the river bank and the other being tie-back or retard lines running from the front lines to the bank.

"The jetty system has the advantage of flexibility," the engineers reported. "The system is permeable, which allows sediment to be carried into the jetty field where it is deposited, with the result that the river builds its own banks. The system is most efficient in sediment-laden streams, and to date, its most common use has been for protection of river banks, bridge abutments, and levees."

They revealed that the U. S. Bureau of Reclamation has now proposed the use of steel jetties for channel alignment.

"To our knowledge the steel jetties have not been used previously in this manner," they reported. "A test reach, the Casa Colorado in the middle Rio Grande project about 35 miles below Albuquerque, is now under construction. The section is about four miles in length, and will be used to determine if additional channelization by use of steel jetties is justified.

"In this area of the Rio Grande where there is a water shortage, a river-control measure which will result in a water saving is welcome," they said.

They reported that channelization of the Rio Grande between Elephant Butte and San Marcial has resulted in an estimated saving of about 40,000 acre-feet of water per year, and said that "any additional saving of water from channelization would be greatly helpful."

Psychological Tests in an Engineering Department

(*Continued from page 914*)

estimated that less than 300 psychologists out of 7300 members of the American Psychological Association have specialized in industrial psychology. We are fortunate in this regard in that all the consultants with whom we deal are competent psychologists holding the doctorate degree, but there is no reason why someone with fewer qualifications cannot do a satisfactory job. As a minimum, he should know tests, be familiar with industrial problems, and be able to work with others.

Acknowledgment

Sincere appreciation is expressed to Dr. D. L. Shuker of Psychological Service Institute for the valuable help he gave on portions of this paper dealing with psychological theory. However, responsibility for its interpretation and inclusion remains with the author.

References

"Personnel Management," by W. D. Scott, R. Clothier, and W. R. Spriegel, McGraw-Hill Book Company, Inc., New York, N. Y., 1949.

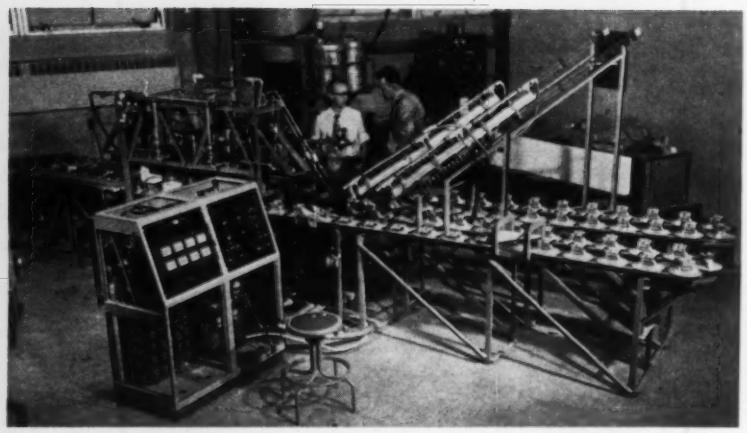
"Experience With Psychological Tests," *Studies in Personnel Policy No. 92*, National Industrial Conference Board, New York, N. Y., 1948.

"Tests of Management," *Fortune*, vol. 42, July, 1950, pp. 92–96.

"Testing and Selection," by Joics B. Stone, *Office Executive*, vol. 31, February, 1956, pp. 9–11.

"The Use of Psychological Tests With Supervisors and Managers," by S. Bunin, 1954, p. 31. Not published.

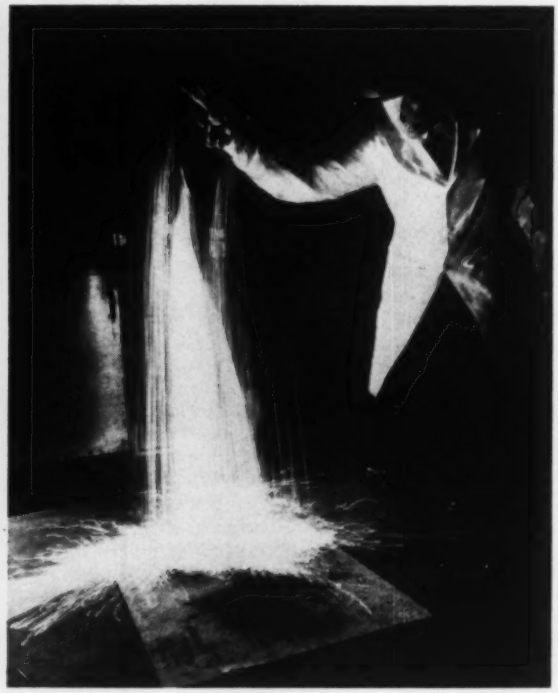
"Tests of Management," *Fortune*, vol. 42, July, 1950, p. 98.



Automation in Action. Here's a new machine which will make a better product, at a lower cost, for the benefit of the consumer. It's an automatic device for producing epoxy-impregnated solenoid coils, used in most home appliances. The equipment was developed for the Controls Corporation of America, Soreng Products Division, Schiller Park, Ill., by Midwest Research Institute of Kansas City, Mo.

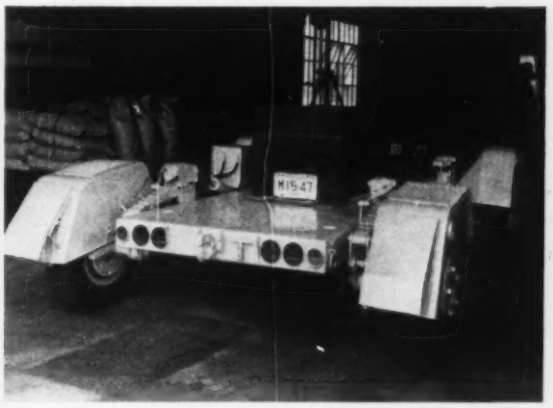
Photo Briefs

75,000-Lb-Capacity Elevator. One of the largest elevators ever built looks like this from an underneath view. Installed in the new Coliseum completed this year in New York, N. Y., it has a lifting capacity of 75,000 lb. Three $15^{13}/_{16}$-in.-diam hydraulic jacks raise the 15 × 48-ft elevator car which will accommodate a fully loaded highway tractor-trailer unit. Elevator has a rise of 62 ft 6 in., serving four floors in the huge Coliseum exhibition hall. Elevator was built by Rotary Lift Company of Memphis, Tenn.



Fiery "Waterfall." Highly purified manganese-bismuth bursts into a fiery waterfall when scattered in air. Since it catches fire spontaneously on exposure to air, the finely ground powder must be prepared and processed in an inert atmosphere of helium gas. The material is virtually 100 per cent pure manganese-bismuth and is said to have significant advantages over existing materials for permanent magnets. The magnetic material was perfected by scientists of the Westinghouse Electric Corporation.

Airplane Baggage Platform Truck. A British truck whose body can be raised as a platform 10 ft into the air is claimed to be the fastest and safest way of carrying baggage and other freight from plane to flight buildings. In this photo the truck gets ready to receive baggage from Pan American World Airways' Clipper, "Morning Star," at London Airport. It was manufactured by the Rootes Group, Devonshire House, Piccadilly, London, W. 1, England.



Double-Purpose Cargo Trailer. A new heavy-duty cargo trailer that quickly converts (by a rectractable hydraulic wheel mechanism) into a sled for use on ice or snow has been developed by American Motors Corporation's Special Products Division. The trailer, recently turned over to the Air Force for further evaluation, was developed by AMC under an Air Force research contract. It is light enough to be transported by air. The prototype vehicle is of 4000 lb capacity.

No Nails. One hundred and thirty-seven tons of southern pine lumber, bonded together in huge arcs with $2^1/_2$ tons of glue (and not a single nail) make up the superstructure of the new Long Island Sports Arena. Each of the 12 supporting arches extends over a clear span of 205 ft and has a linear arc measurement of 240 ft. The superstructure has been erected at Commack, L. I., by Roof Structures, Inc., of New York, N. Y. Designed to seat 7000 persons with every customer having a completely unobstructed view of the sports event, the arena will be provided with an ice rink bigger than that of Madison Square Garden. It will be topped by a semicircular roof which will rise to 65 ft above the arena floor at its center.

European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

Jochenstein hydroelectric station on the Danube River, showing six sluice gates, turbine house, and two navigation locks. (View looking upstream, Austria on *left,* Bavaria on *right.*)

Hydroelectric Power in Europe

GROUP A of the program of papers which was discussed at the Fifth World Power Conference at Vienna, Austria, was one of the largest of the 18 sections, containing 42 papers. Its general title was "Survey of the Development of the National Power Economies from 1950 to 1954," and, though by no means all of the participating countries contributed to it, those which did so were sufficiently important, in the scale of their power requirements and production, to provide a good general indication of the steady growth of world energy demands. There are still some European countries, notably Great Britain, Germany, Holland, and Belgium, in which coal is the main source of electric power, and in most of these it is likely to remain so for another decade at least. In other countries, however, notable changes are in progress. In France, for instance, more than half of the electric power generated now comes from hydroelectric stations, and this proportion will certainly increase in the future. In Italy, the proportion of hydroelectric power is rather more than 85 per cent, but natural gas is coming into increasing use, and, though this fuel is not likely to be employed to any extent for electricity generation, its use in other directions may well affect the national-energy balance-sheet by taking over a larger proportion of the gross demand. Sweden's hydroelectric power system is still being extended and now supplies some 95 per cent of the total load, but the demand is still growing, and at such a rate that the possibility of taking a supplementary supply of electricity from Norway is being seriously examined. It may be remarked in this connection that the suggestion was made, some years ago, that Great Britain might obtain current directly from Norway by power cables laid across the North Sea, as Denmark actually does from Sweden at certain periods of the year; at other times, Denmark's steam-power stations supply current to Sweden, using the same cables. A similar interchange system between England and France, across the Straits of Dover, has been under consideration for some time by the Central Electricity Authority in England, and Electricité de France, and the discussions have now reached the stage where a start on the work may be expected next year.

Power From the Danube River

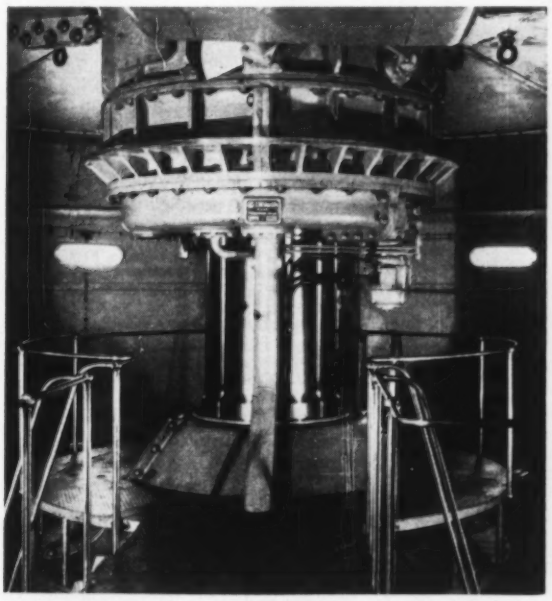
AN international hydroelectric power development of a somewhat different character, which is likely to be the precursor of others, is that which is now well advanced on the Danube River. It is the result of anagreement between the Federal Republics of Austria and of Germany and of the Free State of Bavaria for the joint construction and operation of a series of 14 stations along the stretch of the river which serves as a frontier between these States. So far, only one station, that at Jochenstein, about 22 km below Passau, is in operation, and with only two of the five 28,000-kw sets that it will eventually contain. A third set is now in process of

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

erection. At Persenbeug, another 56 km downstream, a second station is in process of construction, but work on this is not yet very far advanced.

At Jochenstein the minimum flow at low water is 13,000 cfs, with a useful head of 42 ft. The mean flow is 50,000 cfs, with a head of 33 ft. The turbines have been designed for a flow of 62,000 cfs to give 140 mw with a head of 31 1/2 ft. They have been constructed by the German firm of J. M. Voith, of Heidenheim, and are of the Kaplan type, with an operating speed of 65.2 rpm and a runaway speed of 177 rpm. Their designed output is 39,400 hp each. The runner diameter is 24 ft 3 in., and each turbine weighs 690 long tons. The synchronous three-phase generators, which deliver 35,000 kva at a power factor of 0.8, are directly coupled to the turbine shafts and generate current at 9000 v and 50 cps. Each generator weighs about 315 long tons. There are five three-phase transformers, with a ratio of 9 to 220 kv and a voltage control which ranges from 180 to 280 kv.

Since the maximum flood-water flow of the Danube at this point is some 340,000 cfs—five and one half times the designed capacity of the turbines—six large sluice gates have been provided, capable of discharging 60,000 cfs each at the maximum opening. Each gate span has a clear width of 79 ft, and the axis of the dam is curved downstream on the Austrian side to a radius of 4900 ft to assist the discharge of flood water. The gates are of the double-lift hook type, with an effective height of closure of 38 ft 9 in., but normally the lower gate sections will not be used, when all five turbines are running, until the water flow exceeds 150,000 cfs. No gate crane is provided, as a 100-ton floating crane is available for the insertion of dam beams when required.



Turbine shaft and bearing for Jochenstein power station. Constructed by the German firm of J. M. Voith, the turbine is of the Kaplan type, with a runner diameter of 24 ft 3 in., an operating speed of 65.2 rpm, and a designed output of 39,400 hp.

At the Bavarian end of the dam there are two chamber-type locks for the river traffic, each 79 ft wide and 755 ft long. Each has miter gates at the downstream end with an effective height of 50 ft and capable of being opened and closed in 2 min. At the upstream end, different types of gates are fitted. The southern lock has a low-level sill and a vertically moving gate in two sections, giving an effective height of 40 ft 3 in. For filling the lock the lower section is lifted 4 ft 3 in. at the rate of 4 in. per min; then the upper section is lowered by 12 ft 6 in. at the rate of 6 1/2 ft per min for the passage of ships. The northern lock has a high-level sill and a single-piece falling gate with an effective height of 14 ft. The upper gates of both locks can be lifted clear of the water for flood-water discharge or for necessary repairs; if this is done during times of flood, the maximum discharge through the dam can be increased to 390,000 cfs, or 50,000 cfs more than the greatest flow yet observed. At the minimum navigable water level, the southern lock requires a maximum of 13.8 min to fill and the northern lock 15.8 min. The emptying period is 13.9 min. Each lock chamber will accommodate a tugboat and four barges, towed in pairs abreast.

An incidental problem which arises from the joint character of this undertaking, between States which may experience fluctuating rates of monetary exchange, is that of establishing a common basis on which the operating staffs, drawn from both sides of the frontier, can use the power-station canteens for their meals. This has been solved by the issue of tokens, each State having its own "Kantinengeld," which the nationals of the State can buy in their own currency and use as money in the canteens.

Universal Milling Machine

A UNIVERSAL milling machine with a rapid traverse in all three directions was exhibited for the first time at the recent International Machine Tool Exhibition in London, England. It is made by the firm of Adcock & Shipley, Ltd., Leicester, who have specialized in this type of machine for many years. It has a table measuring 50 in. by 10 in. and having three T slots. The longitudinal and cross-feed rates are variable between 3/4 in. and 30 in. per min, and the vertical feed between 3/8 in. and 15 in. With the fast traverses engaged, the rates are 100 in. and 200 in. longitudinally and across, and 50 in. and 100 in. vertically. The table can be swivelled 47 deg on either side of the center. The spindle nose has an external diameter of 3 1/2 in. and is bored 1 3/4 in., with a taper of 3 1/2 in. per ft. The twin overarms are 3 in. in diam, with their centers 7 1/2 in. from that of the spindle. The maximum distance from the spindle nose to the arbor brace is 21 in., and from the spindle center to the table top, 17 1/2 in. There are 24 spindle speeds, ranging from 30 to 1200 rpm. The driving motor is of 4–5 hp and either a single-speed or a two-speed motor can be supplied, but only 12 speeds are obtainable with the single-speed motor. With a motor running at 1400 rpm, these speeds range from 30 to 600 rpm; with a 2800-rpm motor, 60 to 1200 rpm. The feed ranges with alternative speeds (nine feeds to each) are 3/4 in. to 15 in. per min in the low-speed range, and 1 1/2 in. to 30 in. in the high speed. The hardened table screw is fitted with a positive backlash eliminator. Push-button oiling is provided for all slides.

ASME Technical Digest

Substance in Brief of Papers Presented at ASME Meetings

Applied Mechanics

A Theory for Base Pressures in Transonic and Supersonic Flow, by H. H. Korst, University of Illinois, Urbana, Ill. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-30** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

A PHYSICAL flow model is devised based on the concepts of interaction between the dissipative shear flow and the adjacent free stream together with information concerning the mechanical energy distribution within the compressible jet boundary, in order to satisfy quantitatively the conservation of mass in the wake.

The model of the flow mechanism exemplified for the two-dimension case is illustrated depicting the following flow regions: (*a*) Flow approaching the trailing edge, between cross sections 0 and 1; (*b*) flow expanding around the trailing edge, between 1 and 2; (*c*) flow along the wake with constant pressure mixing within the compressible jet boundary, between 2 and 3; and (*d*) recompression at the end of the wake, e.g., by a plane shock between 3 and 4.

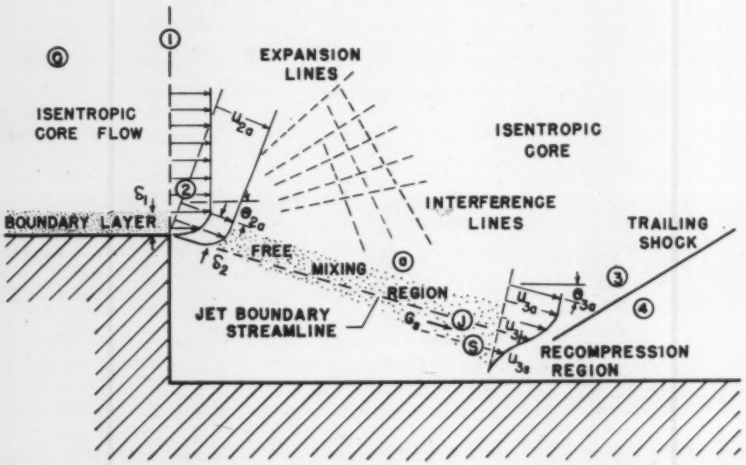
A unique and stable solution results for the base pressure. Theoretical results obtained for thin approaching boundary layer do not require empirical information and are, therefore, best suited to evaluate the merits of the theory. Here emphasized is the case of isoenergetic constant-pressure mixing in the turbulent free-jet boundary, and agreement is found between theory and experimental data.

Electronic Analog-Computer Solutions of Nonlinear Vibratory Systems of Two Degrees of Freedom, by C. P. Atkinson, University of California, Berkeley, Calif. 1956 ASME West Coast Applied Mechanics Conference paper No. **56—APM-38** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

THE main contribution of this paper is its account of the use of an electronic differential analyzer for solving the exact differential equations of certain two-degrees-of-freedom nonlinear vibrating systems and the comparison of the differential-analyzer solutions with the approximate analytical solutions obtained from a single-term harmonic approximation (Ritz approximation). The results of these two methods for solving nonlinear differential equations compare favorably over much of the ranges of variables. Where discrepancies arise between the results of the two methods the value of the differential-analyzer approach can be practically appreciated. For example, in the region where superharmonics might be expected, the single-term harmonic approximation ignores them, while the analyzer solutions contain the superharmonic components of the exact solution.

A secondary contribution of the paper is the account of the use of the differential analyzer for verification of suspected stability criteria for two-degrees-of-freedom nonlinear vibrating systems. Analytical solutions that were reproducible on the analyzer were considered stable; those that were not reproducible were considered unstable.

This paper also can be considered as a call for further application of modern computer techniques to the problems of nonlinear mechanics. Since the computer solves the exact or complete differential equations, the results are the complete solutions including transient phenomena, steady state, subharmonics, superharmonics, and so on. These exact solutions are produced as functions of time which are analogous to the actual vibrations of the physical system studied.



Model of flow mechanism for two-dimensional base-pressure problem with four flow components

---

The Influence of Blast Characteristics on the Final Deformation of Circular Cylindrical Shells, by P. G. Hodge, Jr., Mem. ASME, Polytechnic Institute of Brooklyn, Brooklyn, N. Y. 1956 ASME West Coast Applied Mechanics Conference paper No. **56—APM-25** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

THE final maximum deformation of a reinforced circular cylindrical shell caused by a briefly applied, intense loading is considered. The maximum deformation is obtained in a form which requires a double quadrature of the pressure where the limits of the integration are determined from side conditions. Attempts are made to find a simple analytic approximation, but the attempts are unsuccessful for loads of practical importance. A straightforward graphical-numerical method of solution is devised. Several

examples are considered in support of the conclusions.

The shell is assumed to be infinitely long, so that end effects may be neglected. The load is assumed to be applied to the entire shell simultaneously. The shell is assumed a perfect cylinder, and the reinforcements are taken as rigid. Finally, the shell is assumed to be made of an ideal rigid-plastic material which satisfies a certain simplified yield condition and the associated flow rule.

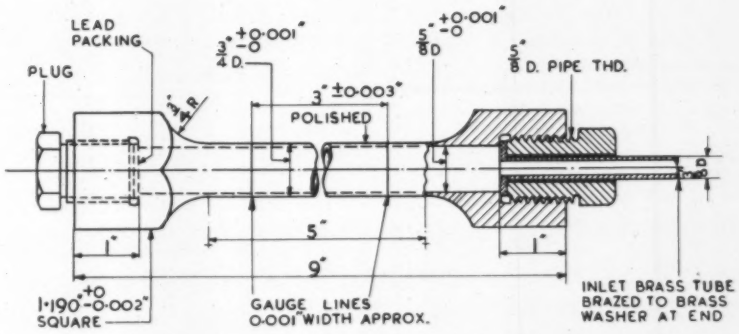
Axisymmetrical Buckling of Circular Cones Under Axial Compression, by Paul Seide, The Ramo-Wooldridge Corporation, Los Angeles, Calif. 1956 ASME West Coast Applied Mechanics Conference paper No. **56—APM-36** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

THE axisymmetrical buckling of right circular cones under axial compression is investigated. A simple expression is obtained for long cones of constant thickness, relating the cone buckling load to the buckling load of a long cylinder of equal thickness and the cone semivertex angle.

In view of the extreme complexity of the differential equations involved, it appears practical to consider the axisymmetrical mode of buckling of circular cones in an attempt to obtain some idea of the effects of taper. The Timoshenko method is used. Although a particular mode of buckling is assumed, the results of the present paper should be useful in determining the actual buckling load of cones of moderate length. Investigations indicate that the theoretical axial buckling load of relatively long cylinders is given by the axisymmetric buckling load, and a formula is given whereby the actual buckling load can be expressed.

Three "Neutral" Loading Tests, by S. S. Gill, University of Manchester, Manchester, Eng. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-18** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

THREE tests have been carried out using hollow tubes of alpha brass subjected to combined torsion and internal pressure. An initial torque was applied sufficient to cause plastic deformation, and then the torque was decreased and the internal pressure increased to keep the octahedral shear stress constant in two tests and the maximum shear stress constant in the third test. These loading paths were chosen because they would be neutral loading if the material obeyed the von Mises-Hencky or Guest yield criterion, respectively. Shear strain, axial, and circumferential strain were measured. All three tests gave some plastic strain during the "neutral" loading, but the constant maximum shear-stress loading gave much larger plastic strains than the constant octahedral stress loading. The plastic-strain increment vectors are plotted to illustrate their direction relative to the loading path.



Specimen for three "neutral" combined torsion and internal-pressure loading tests

In the specimen the ratio of wall thickness to radius is relatively high, but this had to be accepted in view of the difficulty of machining the long $^5/_8$-in.-diam bore and obtaining good concentricity. The material used was a nominally pure 70–30 alpha brass. The composition was as follows: Cu 71.78 per cent, Zn 28.07 per cent, Sn 0.08 per cent, and Fe 0.07 per cent. It was annealed in a sealed box at 400 C for $1^1/_2$ hr and allowed to cool in the furnace.

The Modes of Vibration of a Certain System Having a Number of Equal Frequencies, by D. C. Johnson, University of Leeds, Leeds, England, and R. E. D. Bishop, Pembroke College, Cambridge, England. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-16** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

THIS paper is concerned with a conservative system, which represents an idealized bladed rotor, whose principal modes are indeterminate. The dynamical behavior of the system is discussed and a method of selecting suitable principal modes and co-ordinates is explained.

The analysis of the vibration of the system has been found by the authors to help in the understanding of the behavior of a turbine disk which carries a large number of similar blades. The disk motion may then be angular about its axis or translational and perpendicular to its plane or a combination of these. The analysis is also of general interest because it concerns a system which has a large number of equal frequencies. The analysis for such a system is slightly different from that for a normal system.

Buckling of Rectangular Plates Uniformly Compressed in Two Perpendicular Directions With One Free Edge and Opposite Edge Elastically Restrained, by P. Shuleshko, N. S. W. University of Technology, Sydney, Australia. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-20** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

SPECIFIC cases of buckling of elastic plates are discussed. A rectangular thin elastic plate is assumed with two opposite edges $x = 0$ and $x = a$ simply supported, the edge $y = b$ elastically built into a medium which is characterized by the coefficient r_1, and the edge $y = 0$ free. The plate is compressed in its middle plane by means of uniformly distributed forces of intensity P_1 along edges $x = 0$ and $x = a$ and P_2 along the edges $y = 0$ and $y = b$ where $P_1 = \nu P_2$ and $0 \leq \nu \leq \infty$. By gradually increasing P_2 the condition will be reached at which the flat form of equilibrium of the compressed plate will become unstable and a slight lateral force will produce a lateral deflection which does not disappear when the lateral force is removed.

Four separate cases of buckling of rectangular plates are derived: (*a*) buckling of plates uniformly compressed in two perpendicular directions in which the edges $x = 0$, $x = a$, and $y = b$ are simply supported but edge $y = 0$ is free; (*b*) the same as (*a*) but with the edge $y = b$ rigidly built in; (*c*) buckling of plates uniformly compressed only in the y-direction in which the edges $x = 0$, $x = a$ are simply supported, edge $y = 0$ is

free, and edge $y = b$ elastically built into a medium which is characterized by the coefficient r_1; and (*d*) the same as (*c*) but compression is in the x-direction only.

On the Transmission of a Concentrated Load Into the Interior of an Elastic Body, by G. L. Neidhardt, American Steel Foundries, Chicago, Ill., and Eli Sternberg, Assoc. Mem. ASME, Illinois Institute of Technology, Chicago, Ill. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-35** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

AN EXACT solution in series form is presented for the stresses and displacements in an elastic body bounded by one sheet of a two-sheeted hyperboloid of revolution, subjected to an axial concentrated load at the vertex. The problem is reduced to one governed by finite surface tractions with the aid of a scheme developed in a previous paper, and the solution is based on the Boussinesq stress functions referred to spheroidal coordinates. The corresponding known solutions appropriate to the half space and to the circular cone are obtained as limiting cases.

Numerical results are given for the normal stress on planes perpendicular to the axis of symmetry, at points on this axis. These values are utilized in a discussion aimed at the influence of the curvature of the boundary at the load point upon the transmission of the load into the interior of the body. The results indicate that this influence may be considerable.

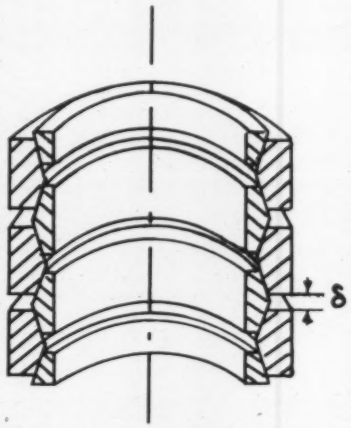
A Study of Orthogonally Stiffened Plates, by W. H. Hoppmann, 2nd, Mem. ASME, The Johns Hopkins University, Baltimore, Md., N. J. Huffington, Jr., Assoc. Mem. ASME, Virginia Polytechnic Institute, Blacksburg, Va., and L. S. Magness, Assoc. Mem. ASME, The Johns Hopkins University, Baltimore, Md. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-11** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

THIS paper attempts to estimate the bending and twisting compliances for orthogonally stiffened plates, using beam theory as a guide. In a recent paper by one of the authors, a method of systematically determining elastic compliances of stiffened plates by a set of consistent experiments was proposed. In the present paper further experimentation based on the method is described and discussed. In particular, the distribution of strain is studied along with frequency of flexural vibration. For the purpose, two different designs of stiffened plates were investigated.

Some details of calculations based on the theory as well as experimental results are provided in curves and tables. Sufficient verification of the theory is obtained to warrant serious consideration of possible use of the method for design purposes.

Wave Propagation in an Elastic Rod Exhibiting Internal Coulomb Friction, Considered as a Model for a Ring Spring, by E. H. Lee, Mem. ASME, and A. J. Wang, Brown University, Providence, R. I. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-5** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

THE problem of stress-wave propagation in a ring spring is considered. A ring spring consists of rings placed normal to the spring axis with alternate internal and external conical bearing surfaces. The friction between these surfaces causes a loading-unloading relation which is strongly irreversible, leading to marked energy absorption for oscillatory stressing. The attenuation of a pulse of stress is analyzed in detail as it is propagated down a spring of infinite length. The influence of certain spring characteristics is evaluated. Concentration of the absorption of the total input energy is found in the region of the impact end of the spring, and particular examples are presented.



Segment of a ring spring showing placement normal to the spring axis

Impulsive Loadings of Elastic-Plastic Beams, by J. A. Seiler, B. A. Cotter, and P. S. Symonds, Mem. ASME, Brown University, Providence, R. I. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-17** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

A SIMPLY supported uniform beam of ductile material, subjected to impulsive loading such that the initial velocity is a half-sine wave, is considered in this paper. The elastic and elastic-plastic motions are discussed under the assumption that plastic flow is confined to one cross section, and the final deformations are compared with those computed from an analysis which neglects all elastic deformations. The purpose of the work is to provide further information which may help in estimating the range of validity of the latter type of analysis.

Thermal Stresses in Infinite Elastic Disks, by Brahmadev Sharma, Birla College, Pilani, Rajasthan, India. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-19** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

IN THIS paper a direct method of finding thermal stresses in an elastic body due to any temperature distribution is presented. The steady state is discussed and the results are applied to find stresses in a disk of thickness d and infinite radius attributable to axisymmetric temperature distribution. A second problem of a semi-infinite solid, in which the elastic properties change at a depth d, also is solved. Finally, as a special case, a circular portion of the upper surface of the disk is supposed to be at a uniform temperature while the remainder of the surface is kept at zero temperature. Stress distribution and deformation on the surface for a semi-infinite solid also are found. A general solution for an unsteady state is given.

Impact With Finite Acceleration Time of Elastic and Elastic-Plastic Beams, by R. C. Alverson, Brown University, Providence, R. I. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-14** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

THE purpose of the work described in this paper is to provide information on the elastic and plastic deformation of steel beams subjected to transverse impact. The particular impact problem treated was chosen to correspond to conditions in tests in which a beam initially at rest is struck by a massive

hammer, so that a specified change of velocity is imposed at a certain cross section in a small time interval.

In the present analysis the initial elastic and subsequent elastic-plastic motions were obtained by methods similar to those used by Bleich and Salvadori. It is assumed that plastic deformation occurs only at a single stationary plastic hinge (in this case at the struck cross section). Results obtained are compared with those of a "rigid-plastic" solution of the same problem, in which plasticity conditions are correctly taken into account but elastic vibrations are not included.

The Propagation of Fatigue Cracks, by A. K. Head, Aeronautical Research Laboratories, Department of Supply, Melbourne, Australia. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-15** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

A THEORY of the rate of growth of fatigue cracks is extended to the case of large stresses. The paper discusses recent measurements of McClintock and Ryan, who have recently presented the results of an experiment designed to test a theoretical analysis of the rate of growth of fatigue cracks, in particular, the dependence of rate of growth on stress; while finding agreement with some predictions of the theory, they also point out apparent discrepancies. These are discussed.

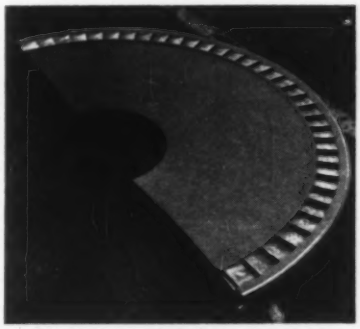
The growth of a fatigue crack is visualized as follows: If the crack were in a purely elastic solid, then the applied stress would generate a high stress at the tip of the crack, as a result of the large stress concentration there. In a metal this high stress would be above the yield stress, and a plastic region would be created ahead of the tip of the crack.

This process by which a fatigue crack is visualized to extend is too complicated for solution by present methods of mathematical plasticity. Therefore a model of the process was proposed which was simplified sufficiently to be tractable yet retain the essential features.

McClintock and Ryan have suggested a number of properties the model might have which would make it closer to a real crack. One improvement was considered, namely, to allow the plastic elements to be elastic plastic instead of rigid plastic. This leads to a floating-boundary problem with a more complicated set of equations. These could be solved only by making further mathematical approximations, and the final result was not essentially different from that for rigid-plastic elements. Any inherent improvements were apparently lost by the more drastic approximations necessary to find a solution. It would appear that to introduce, and retain, improvements in the model is essentially a mathematical problem calling for a more exact analysis than has been used so far.

Bending of a Uniformly Loaded, Semicircular Plate, Simply Supported Around the Curved Edge and Free Along the Diameter, by D. F. Muster, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y., and M. A. Sadowsky, Mem. ASME, Rensselaer Polytechnic Institute, Troy, N. Y. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-7** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

WITHIN the limits of classical plate theory, a solution is obtained in series form for the problem of a uniformly loaded, semicircular plate, simply supported around the curved edge and free along the diameter. The solution, although singular at the corners, is otherwise analytic and amenable to numerical evaluation by electronic calculators. The solution results are compard to those obtained experimentally by Robinson and Huggenberger. The agreement is reasonable, when account is taken of the manner in which their empirical results were obtained.



Typical steam-turbine diaphragm split transversally along a horizontal diameter

The particular problem considered here is an idealization of one which occurs in the design of steam turbines. Turbine stages are separated by circular "diaphragms" split transversally along a horizontal diameter. Each of the semicircular sections contains a row of stator buckets and a concentric circular cutout which fits closely around the rotor shaft. The curved edge of the diaphragm rests against a matching projection which is integral with the stator shell.

The Effect of Shear on the Plastic Bending of Beams, by D. C. Drucker, Mem. ASME, Brown University, Providence, R. I. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-28** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

THE end-loaded cantilever beam of perfectly plastic material is studied in this paper. As a first step in extension to plates, the author explores the concept of an interaction curve relating limiting values of shearing force and bending moment for perfectly plastic beams. Simple illustrations demonstrate that, far more than in the elastic range, such interaction is not just a local matter but depends upon the geometry and loading of the entire beam. Useful interaction curves are obtained, nevertheless, with the aid of the upper and lower bound techniques of limit analysis, choosing the maximum-shearing-stress criterion of yielding for convenience. It is shown, in particular, that although a small amount of shear produces but a second-order reduction in the limit moment of beams, a small moment reduces the limiting shear value by a first-order term.

On the Stresses in a Strip Under Tension and Containing Two Equal Circular Holes Placed Longitudinally, by A. Atsumi, Tôhoku University, Sendai, Japan. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-12** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

A PROBLEM of determining the stresses in an infinite strip of finite breadth under tension and containing two equal circular holes placed on the longitudinal axis is studied theoretically. Stresses are calculated by a perturbation method, in each case the radius of the circle and the distance between the centers of two holes being varied.

From a consideration of the results given in this paper the following conclusions seem to be justified: (1) The values of stress-concentration factor for the case treated in this paper are smaller than the values for the case of a single hole of the same geometry given by Howland. Further, as the two circular holes come close together, the values of the stress-concentration factor decrease;

(2) the decrease of the stress-concentration factor for the case of two holes considered here is smaller than for the case of a large number of circular holes; and (3) stresses along the periphery near the other hole are smaller than those for a single hole as given by Howland, while the stresses along the other side of the periphery are larger.

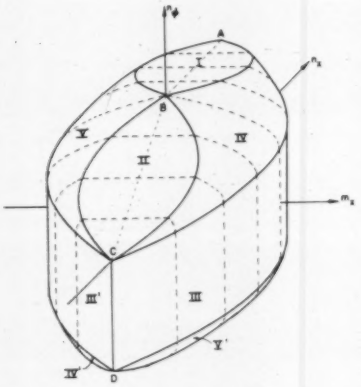
The Tapered-Land Thrust Bearing, by C. F. Kettleborough, University of Melbourne, Melbourne, Australia. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-21** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

NEGLECTING side leakage, the maximum load capacity which can be carried per unit width is obtained when there is a stepped convergence to the oil film. However, when side leakage is considered, the stepped bearing is only slightly better than the tilting-pad bearing, this being due to the fact that the maximum oil pressure occurs at the step where the oil-film thickness is a maximum and hence there is easy means of escape for oil. The tapered-land bearing does not suffer from this disadvantage, and computations have been carried out which show that the maximum load this bearing is capable of supporting is about 14 per cent greater than the maximum load capable of being supported by the tilting-pad bearing, both cases not neglecting side leakage. Some numerical calculations are made.

Minimum-Weight Design of Cylindrical Shells, by Walter Freiberger, Brown University, Providence, R. I. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-33** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957.)

THE theory of collapse and minimum-weight design of cylindrical shells by Onat and Prager is applied in this paper to the development of a method for designing the variable wall thickness of a cylindrical shell under axial loading and arbitrary pressures to give maximum economy of material. The design is such that the shell does not fail plastically in the sense used in limit analysis. It is assumed that the shell is supported at the ends by inextensible rings so that the circumferential strain rates vanish there.

The diagram shows the yield surface of cylindrical shells developed by Onat. It consists of a number of intersecting planes and surfaces to make up a convex surface in space. For maximum economy of material the generic point of the stress state of the shell must move on the edges separating the various domains of the yield surface. This result is a consequence of the argument that, to achieve minimum weight, the shell must be designed in such a manner that any admissible collapse mode is a linear combination of a number of independent collapse modes, this number being equal to the number of independent variables at the designer's disposal. For a shell with continuously varying wall thickness the number is infinite.



Yield surface of a cylindrical shell

Kinematic Phenomena Observed During the Oblique Impact of a Sphere on a Beam, by Werner Goldsmith, Assoc. Mem. ASME, and D. M. Cunningham, Assoc. Mem. ASME, University of California, Berkeley, Calif. 1956 ASME West Coast Applied Mechanics Conference paper No. **56—APM-40** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

EXPERIMENTAL data relating to the kinetics of oblique impact of a ½-in-diam steel sphere upon steel beams at initial velocities ranging from 30 to 150 fps are presented. The variation of beam deflection, contact duration, trajectory of the sphere, and contour topography with angle of incidence, beam size, and initial velocity are determined, and the velocity of propagation of several waves is ascertained.

The current paper is the third of a sequence of articles describing the results of an experimental investigation of the oblique impact of a steel sphere upon steel beams. The present work pertains to data delineating the kinematic history of the ball and beam as well as to wave-propagation measurements deduced from strain gages placed longitudinally at various positions on the distal side of the beam.

The following conclusions may be drawn from the experimental investigation of the contact phenomena and kinematic history of the oblique impact of spheres upon simply supported beams: (*a*) The magnitude of successive beam deflections indicated the presence of little damping in the system; (*b*) contact durations decrease with increased beam flexibility and decrease with increased velocity for normal incidence in a manner similar to that predicted by the Hertz theory of contact; (*c*) considerable deviation exists between crater dimensions measured at the crater lip and the median plane of the beam; and (*d*) the earliest measurable signal propagates at a velocity corresponding to that of longitudinal waves in rods.

Transient Response of a Nonlinear System by a Bilinear Approximation Method, by E. I. Ergin, Scientific Advisory Board, Turkish General Staff. 1956 ASME West Coast Applied Mechanics Conference paper No. **56—APM-37** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

A LINE-SEGMENT approximation for a nonlinear elastic force has been developed which makes it possible to obtain analytical solutions to a number of transient-load problems which formerly could be solved only by graphical or numerical methods. It is shown that for many problems involving even large nonlinearities, two line segments only are sufficient to give satisfactory accuracy. For some problems, where the classical analytical approximate methods of Lindstedt or of Kryloff and Bogoliuboff can be applied, it is shown that the bilinear method leads to an improved accuracy.

It is shown that for any nonlinearity which can be expressed as a power in the dependent variable, the second slope and the transition point are simple functions of the maximum amplitude. It also is shown that for small nonlinearities the solution of the problem in many cases is insensitive to the exact choice of the maximum deflection used to calculate the parameters of the bilinear approximation, and hence the choice of the linear maximum amplitude for this purpose gives satisfactory results.

One of the significant applications of the concept of the line-segment approximation is in the field of electric analog computing. It has always been difficult to synthesize exactly nonlinear functions for the purposes of electrical analog

computations, and approximation by straight-line segments has been one of the common ways of handling the problem. The studies of the present paper indicate that, for many such problems, line-segment approximations of a simple form will give results which are well within the accuracy of an analog computer.

An Experimental Investigation of Beam Stresses Produced by Oblique Impact of a Steel Sphere, by D. M. Cunningham, Assoc. Mem. ASME, and Werner Goldsmith, Assoc. Mem. ASME, University of California, Berkeley, Calif. 1956 ASME West Coast Applied Mechanics Conference paper No. **56—APM-41** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

AN EXPERIMENTAL investigation designed to study the phenomena incident to the oblique collision of ½-in-diam steel spheres with mild steel and annealed drill-rod beams at oblique angles of incidence is discussed in this paper. Initial ball velocities ranged from 30 fps to 150 fps, beam sizes varied from $^1/_4$ in. × $^3/_4$ in. to $^3/_4$ in. × $^3/_4$ in., angles of incidence were chosen from 85 deg to normal incidence, and simply supported, clamped, and free beams were employed.

Information is reported concerning the values of maximum bending stress at various positions along the beam as a function of the angle of incidence and as a function of beam size for various angles of incidence. The progressive dispersion of the initial transient is examined in detail. The effect of end supports, effective beam length, and repetitive shots into the same hole upon stress are described.

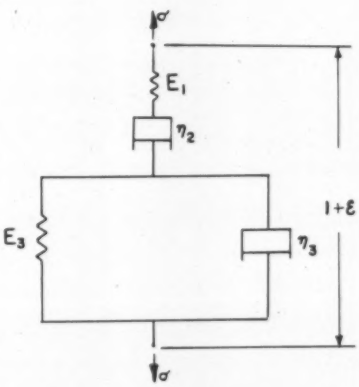
Stress Solutions for an Infinite Plate With Triangular Inlay, by R. M. Evan-Iwanowski, Syracuse University, Syracuse, N. Y. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-4** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

THE method of solving two-dimensional problems in elasticity by means of the functions of complex variable, essentially developed by E. Goursat and N. I. Muskhelishvili, has been applied to the following cases: (*a*) an infinite plate with a rigid triangular inlay under uniform tension at infinity, (*b*) a concentrated force, and (*c*) a moment acting on a triangular inlay in an infinite plate. All these problems are second boundary-value problems; i.e., the displacements are prescribed on the boundary. The first boundary-value problem for a triangular opening in an infinite plate was treated by Hu Nan Chu. The mapping function used in this paper is $z = \omega(\zeta) = K\left(\zeta + \frac{n}{\zeta^2}\right)$, K is real, $0 < n < 1/2$ and real, and it maps an exterior of a triangle with rounded corners in the z-plane into an exterior of a unit circle in the ζ-plane.

On the Determination of a Viscoelastic Model for Stress Analysis of Plastics, by D. R. Bland, King's College, London, England, and E. H. Lee, Mem. ASME, Brown University, Providence, R. I. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-26** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

A METHOD of assessing whether or not the measured variation of complex compliance with frequency for a viscoelastic material is consistent with a four-element model is presented.

The four-element model offers the possibility of representing material behavior adequately since it exhibits the three main types of deformation found in viscoelastic materials: (*a*) instantaneous elastic response associated with the spring element E_1 (*b*) viscous flow associated with the dashpot η_2, and (*c*) delayed elastic response associated with the Voigt unit of spring and dashpot in parallel, $E_3\eta_3$. It is the simplest model which exhibits all three phenomena.



Four-element model for stress analysis of plastics

If the compliance measurements are found to conform with the behavior of a four-element model over the whole or part of the frequency range studied, a graphical method of determining the model constants is presented. The significance of the application of such a model to stress analysis under transient loading is discussed.

Hydraulics

Hydraulic Accumulator Applications, by J. R. Hemeon, Mem. ASME, General Motors Corporation, Trenton, N. J. 1956 ASME Semi-Annual Meeting paper No. **56—SA-59** (multilithographed; available to April 1, 1957).

THIS paper presents formulas for use in selecting the proper type and economic size of accumulator to develop optimum performance and a minimum of downtime by extending the satisfactory months between scheduled shutdown for preventive maintenance recharge with nitrogen and overhaul.

For the selection of an economic size of the bladder accumulator, the following formula is given:

$$G' = C'\,\Delta V$$

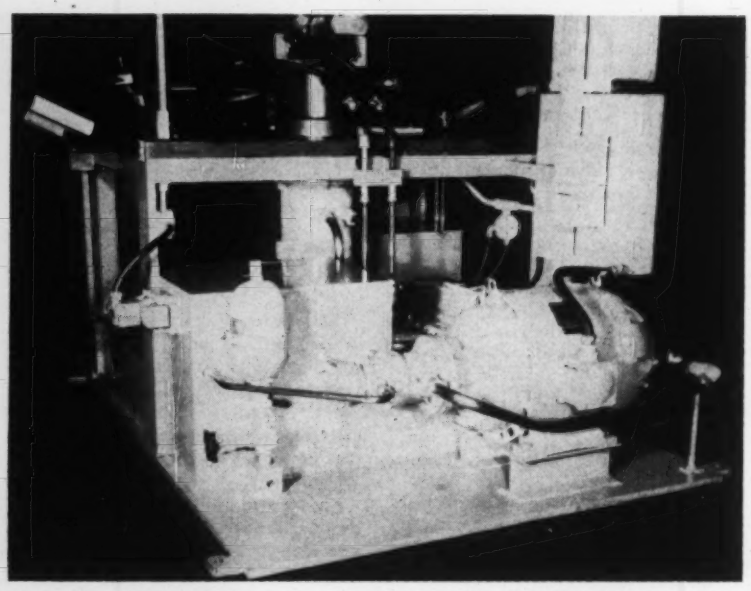
where G' = gallon rating of accumulator for gas efficiency, C' = calculation constant for factor of ignorance or knowledge, and ΔV = theoretical demand volume of work stroke.

To determine the time between nitrogen service charging, this formula is given:

$$M' = \left(\frac{V}{\Delta V}\right)^n \times \frac{N \times 10^7}{(P{\cdot}2)^n} \times \frac{1}{\sqrt{D}}$$

where M' = maintenance months between nitrogen service charging; N = numerical value selected from many years of experience on production equipment; P = pressure, psi gage; D = design factor of ignorance or knowledge; and V = volume of gas in accumulator ($V{\cdot}1$ = volume at nitrogen precharge; $V{\cdot}2$ = volume at $^2/_3$ gas in top, ready to work; and $V{\cdot}3$ = volume of gas at end of work stroke).

The use of these formulas is illustrated in various applications. One of these, pictured here, is the power plant at the rear of a 75,000-in-lb torque capacity bender, which bends outside trim molding for automobile bodies. This rear view shows a 15-hp motor on which are mounted two hydraulic pumps. The large inboard pump provides right-hand and left-hand rotary power for the central location hydromotor. The small outboard pump serves a dual purpose. This pump gpm is properly balanced to keep the accumulator charged and to operate the clamp circuit. The 1-gal bladder-type accumulator supplies fluid power to close and maintain the wiper on the stock to the desired force.



Rear view, compact high-torque, three-circuit system bender using two pumps and a bladder-type accumulator

The mathematical calculations for this accumulator are

ΔV (mean of close and open) = 4.66 cu in.

$G' = C'\Delta V = 13.5 \times 4.66 = 63$ cu in. Use a 1-gal accumulator at $V{\cdot}1 = 228$ cu in. for high-cycle rate

$V{\cdot}1 = 228$, $V{\cdot}2 = 152$, $P{\cdot}2 = 450$, $N = 3$, $D = 1.51$

$$M' = \left(\frac{V}{\Delta V}\right)^{1.2} \frac{N \times 10^7}{(P{\cdot}2)^{1.2}} \frac{1}{\sqrt{D}}$$

$$M' = \frac{228^{1.2}}{4.66} \frac{3 \times 10{,}000{,}000}{(450)^{1.2}} \frac{1}{\sqrt{1.51}}$$

$$= 1{,}700{,}000 \text{ cycles}$$

Cycles per month = 4 cycles per part × 400 per hr × 12 hr per day × 25 days per month = 480,000

$$M' = \frac{1{,}700{,}000}{480{,}000} = 3\,1/2 \text{ months}$$

Therefore charge the accumulator every $3\,1/2$ months. Owing to the four accumulator cycles per part and 480,000 cycles per month, the use of a 1-gal accumulator is justified.

If the installation had been at $V{\cdot}1 = 228$, $P{\cdot}2$ at 750, and ΔV at 40.7 cu in., the maximum cycles would be 197,000. This is less than one tenth of the number of cycles which were calculated under conditions for the bender wiper. But at 400 parts per hr, 12 hrs per day, and 25 days per month, the M' months between nitrogen addition would be $1\,2/3$.

The most common errors in application are listed as: (1) selection of the wrong type of accumulator for the job requirement; (2) lack of knowledge of the effect of operating temperature; (3) choice of too small an accumulator; (4) incorrect size of piping and valves and controls for optimum demand velocity; and (5) excessive downtime and short periods between preventive maintenance service.

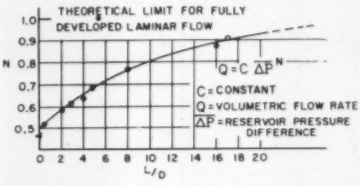
Analysis of Incompressible, Nonviscous, Blade-to-Blade Flow in Rotating Blade Rows, by J. J. Kramer, NACA-Lewis Flight Propulsion Laboratory, Cleveland, Ohio. 1956 ASME Semi-Annual Meeting paper No. **56—SA-66** (multilithographed; to be published in Trans. ASME; available to April 1, 1957).

A METHOD for the solution of the incompressible nonviscous flow through a centrifugal impeller (including the inlet region) with or without splitter vanes is developed and applied to a 48-in-diam centrifugal impeller. Solutions for the entire blade passage are obtained for four weight flows ranging from incipient surge to maximum as determined by actual impeller tests. In addition, these solutions are refined in the leading-edge region. The results are presented in a series of figures showing streamlines and relative velocity contours.

The following results are reported: (1) A large eddy formed on the driving face of the blade at the incipient surge-weight flow but was not present for the three higher-weight flows; (2) The slip factor varied from 0.874 to 0.859 as the weight flow increased; (3) For weight flows of 26.25, 32.10, and 44 lb per sec, a local acceleration followed by a rapid deceleration occurred on the trailing face of the blades at a radius of about 1.3 ft, i.e., where the blade began to curve more rapidly; (4) The mean angle of attack was best predicted by basing the approximate computation on the weight flow, the tip speed, and the annular area minus the blockage of the blades; (5) The stagnation point shifted from the driving to the trailing face of the blade as the weight flow increased, while the local angle of attack varied from 80 to —28 deg; (6) Minimum-velocity gradients around the blade nose occurred for the weight flow corresponding to a mean angle of attack of —4.6 deg, computed from blade speed and the upstream radial-axial velocity for which blade blockage has been taken into account. For this condition the inlet flow was aligned with the driving face of the blade; and (7) A small positive local angle of attack seemed desirable for rounded leading-edge blades.

Pressure Drop and Flow Characteristics of Short Capillary Tubes at Low Reynolds Numbers, by Frank Kreith, Assoc. Mem. ASME, Lehigh University, Bethlehem, Pa., and Raymond Eisenstadt, Assoc. Mem. ASME, Union College, Schenectady, N. Y. 1956 ASME Semi-Annual Meeting paper No. **56—SA-15** (in type; to be published in Trans. ASME; available to April 1, 1957).

THE pressure drop and flow characteristics of short capillary tubes have been investigated experimentally for length-to-diameter ratios varying from 0.45 to 18 at diameter Reynolds numbers ranging from 8 to 1500. In the range of the dimensionless modulus $(L\mu)/(VD^2\rho)$ from 4×10^{-3} to 3 to 10^{-1}, the experimental data agree within 15 per cent with a mathematical theory by Langhaar. At a value of $(L\mu)/(VD^2\rho)$ of about 0.3 the experimental data approach the Poiseuille laminar-flow theory. For very short tubes $(L/D < 0.5)$ the experimental results deviate from Langhaar's theory at values of $L\mu/VD^2\rho$ less



Characteristic flow exponent N versus length-to-diameter ratio for laminar flow

than 4×10^{-3}, and at $L\mu/VD^2\rho$ equal to 5×10^{-4} the pressure drop is twice as large as that predicted by Langhaar's theory. The experimental results for tubes having very short aspect ratios are in agreement with data obtained by Zucrow with short square-edged jets.

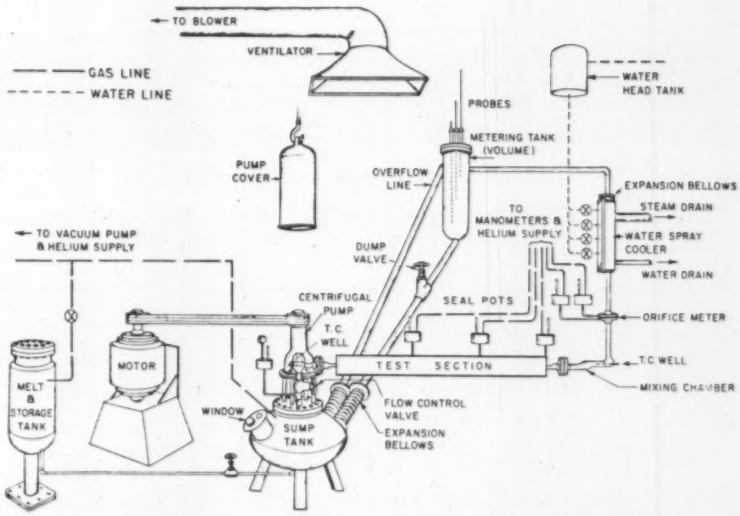
It was found that the flow rate Q through a short capillary tube can be related empirically to the over-all pressure drop Δp raised to a power N. The exponent N is a function of the length-to-diameter ratio L/D varying from 0.5 at L/D equal to 0.45 to 0.91 at L/D of 18. The trend of the curve suggests an asymptotic approach to unity, the exponent for Poisseuille type flow.

The results of this study have application to: (*a*) Simulating flow through screens, doors, cracks, and fissures in small-scale model testing of buildings in atmospheric wind tunnels; (*b*) automatic control devices where capillary tubes are used as hydraulic resistances in a larger line and in nozzle-flapper combinations; (*c*) heat pumps and air-conditioning equipment where short capillary tubes are used as two-way control valves, and (*d*) flow through ompact heat exchangers and porous materials.

Effect of the Volute on Performance of a Centrifugal-Pump Impeller, by R. D. Bowerman, Assoc. Mem. ASME, U. S. Industries Research & Development Corporation, Los Angeles, Calif., and A. J. Acosta, Assoc. Mem. ASME, California Institute of Technology, Pasadena, Calif. 1956 ASME Semi-Annual Meeting paper No. **56—SA-45** (multilithographed; to be published in Trans. ASME; available to April 1, 1957).

An experimental study of volute influence on radial flow-impeller performance was conducted by operating a single impeller with three different sets of volute vanes. In each case, over-all performance was measured and an internal-flow study within the volute was made.

Assembly view of centrifugal-pump components



Lead-bismuth flow circuit, consisting essentially of a centrifugal pump submerged in a closed sump tank, an orifice-metering section, the pressure-drop test section, a calibrated-volume tank, and the necessary piping

The results reported in this paper show that, at their respective design flow rates, the influence of the volutes is least and the deviation of performance from the free-impeller operation is small. At off-design flow rates there are major changes in the impeller performance resulting from the presence of the volutes. Large real fluid effects, coupled with a nonuniform velocity pattern at the impeller exit, result in a flow through the volute that does not resemble a potential flow. Even so, the fluid losses through the volute are comparatively small.

Orifice-Metering Coefficients and Pipe Friction Factors for the Turbulent Flow of Lead-Bismuth Eutectic, by H. A. Johnson, Mem. ASME, University of California, Berkeley, Calif., J. P. Hartnett, Assoc. Mem. ASME, University of Minnesota, Minneapolis, Minn., W. J. Clabaugh, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y., and L. Fried, Assoc. Mem. ASME, General Electric Company, Utica, N. Y. 1956 ASME Semi-Annual Meeting paper No. **56—SA-16** (in type; to be published in Trans. ASME; available to April 1, 1957).

Pipe friction factors and orifice-metering coefficients are reported here for the turbulent flow of lead-bismuth eutectic and are found to be in satisfactory agreement with the results for water flow when compared on the usual dimensionless basis.

The belt-driven centrifugal pump, expressly built for this system, was a vertical-shaft, end-suction volute type which operated submerged in the lead bismuth. The sump tank was ellipsoidal in shape to minimize the required metal charge and, at the same time, to insure a reasonably constant suction head on the pump during the metering period.

The pump discharged through a bellows sealed flow-control valve and then through the pressure-drop test section to the vertical orifice-metering section. From the metering section the fluid flowed through the cooler and into a horizontal line carrying the fluid over to the calibrated-volume tank which normally emptied into the sump.

Conclusions from these tests were that pipe-friction factors for the turbulent flow of lead-bismuth eutectic agree with those for the flow of water when compared on the usual dimensionless basis. However, a relatively large unexplainable spread (±15 per cent) occurs in the results for lead-bismuth eutectic which requires further exploration. When compared at the same orifice Reynolds number and for the same pipe size the flow coefficients for lead-bismuth eutectic and for water are equivalent for sharp-edged orifices with flange taps.

Power

Avon No. 8—A Supercritical-Pressure Plant, by C. A. Dauber, Mem. ASME, The Cleveland Electric Illuminating Company, Cleveland, Ohio. 1956 ASME Semi-Annual Meeting paper No. **56—SA-69** (multilithographed; available to April 1, 1957).

This paper describes the 250,000-kw supercritical-pressure addition to the

Avon Plant of The Cleveland Electric Illuminating Company. Special features of the third supercritical-pressure unit designed for an American central station include the use of a monotube once-through boiler, combination motor and turbine-driven boiler feed pumps, extruded pipe for main steam leads, condenser-bypass demineralization system and a high-temperature water-heating system for the plant addition.

Steam will be supplied to the 250,000-kw supercritical-pressure turbine by a C-E Sulzer monotube steam generator. It will be a pulverized-coal-fired unit of the dual-furnace design, and corner firing using tilting tangential burners will be employed to burn low-ash-fusion-temperature coal. The unit will be designed to deliver 1,715,000 lb of steam per hr to the turbine throttle at 3500 psig and 1100 F with single reheat to 1050 F. The boiler has no drum and is of the forced-circulation once-through type.

The feedwater is divided into a total of four circuits. Two feedwater circuits supply an economizer for each furnace. The feedwater flow to the economizers is controlled in each circuit by individual feedwater control valves. The feedwater then flows to the water walls which occupy approximately the bottom half of the wall surface in each furnace. No conventional downcomers outside of the boiler are required to supply the water wall section. The boiler water makes a number of up-and-down passes in the furnace water wall section before entering the horizontal-tube transition zone which is located in a relatively cool convection region. The transition zone is where water is converted into steam.

The Westinghouse turbine generator is designed for a maximum throttle flow of 1,715,000 lb of steam per hr at a pressure of 3500 psig and temperatures of 1100 F with reheat to 1050 F. With two turbine-driven boiler feed pumps in service, the maximum capability of the main turbine is 250,000 kw. The 3600-rpm inner-cooled generator has a rating of 273,460 kva at 22 kv, 0.85 power factor, 0.64 short-circuit ratio, and 45-psig hydrogen pressure. Provision is made to operate the generator at 60 psig. A 1200-kw exciter driven by a 1750-rpm induction motor operating at 375 volts supplies excitation current.

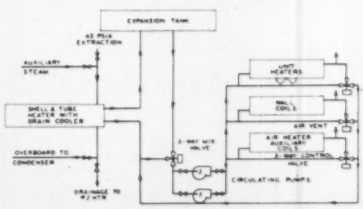
The entire control and protective system on this turbine is hydraulically operated. The main steam controls include servomotors for moving the governor valves which determine the flow to the turbine, the speed-responsive governor, and the speed changer which adjusts the speed range in which the governor will control the servomotors. The interceptor valves are closed during startup and up to a steam flow of 30 per cent of maximum.

There will be three six-stage main boiler feed pumps each capable of delivering 2285 gpm (1,026,000 lb per hr) at a total head of 11,580 ft. Two of the pumps will be driven by steam turbines and the third by two 4000-hp motors in tandem.

The once-through supercritical-pressure boiler design imposes stringent limitations on total solids in the boiler feedwater. Solids formerly blown from the boiler drum can lead to deposit formation in the unit if not removed by other means. Solids in the steam may deposit on the turbine blades.

A condensate-bypass filtration and demineralization system will be used to maintain the solids within the required limits. The bypass filtration and demineralization system serves three major purposes: (1) to protect feedwater cycle from condenser tube-sheet weepage (leakage between tube and tube sheet) and condenser-tube-rupture leakage, (2) to "polish" makeup water from a two-bed demineralizer system, and (3) to remove corrosion products from the cycle.

The conventional low-pressure saturated steam for coil and general-building heating could not economically be used because of the absence of saturated steam from a boiler drum and the desirability of minimizing makeup of high-purity feedwater required for the boilers. Therefore, a high-temperature, closed-cycle forced-circulating hot-water system was selected to permit greater flexibility in pipe runs, smaller size of pipe, and the elimination of trap maintenance.



Avon No. 8 high-temperature water heating system

To obtain high-temperature water, superheated steam will be extracted from the cycle at the 45-psia stage and passed to an ordinary feedwater heater-type heat exchanger equipped with a drain cooler. The condensate will then flash to the No. 2 low-pressure heater. In the high-temperature water circuit, a pump will circulate water continuously at approximately a constant flow rate through the heat exchanger and on through the air-heating coils and unit heaters. In general, control will be provided by a thermostatically controlled bypass valve to bypass water around the heat exchanger. A spare pump will be provided.

An Analytic Procedure for Optimizing the Selection of Power-Plant Components, by W. A. Wilson, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1956 ASME Semi-Annual Meeting paper No. **56—SA-51** (multilithographed; to be published in Trans. ASME; available to April 1, 1957).

THIS paper discusses analytical techniques which may limit the amount of "cut and try" steps followed in the selection of power-plant components. The economic problem of optimization is to minimize the total cost of performing a given task where that cost is the sum of two parts: (1) operating costs and (2) fixed charges. In the case of a power plant the former are closely related to the heat rate and the latter to the total capital investment. In general, the heat rate can be improved by increasing investment.

The analysis is made on the following basis: (1) components, such as coal-handling equipment, which do not influence the power output and can be chosen independently of the rest of the plant; (2) components, such as circulating water system and the condenser proper which co-operate with each other to produce a single common effect through which their influence is felt on the rest of the plant; (3) components, the costs of which are determined solely by the selection of the cycle and the plant rating; and (4) components, such as the turbine exhaust annulus and feedwater heaters, which are subject to modification in finite steps. This breakdown is applied to the problem of selecting the basic components for two 150,000-kw reheat plants.

Predicting Performance of Large Steam Turbine-Generator Units for Central Stations, by H. Hegetschweiler, Mem. ASME, and R. L. Bartlett, Mem. ASME, General Electric Company, Schenectady, N. Y. 1956 ASME Semi-Annual Meeting paper No. **56—SA-52** (in type; to be published in Trans. ASME; available to April 1, 1957).

THE purpose of this paper is to provide the power industry with an up-to-date method for predicting the performance of large steam turbine-generator units. The

fundamental concept of appraising turbine stage performance by stage groups developed by Warren, Knowlton, and Elston is followed. In general, it assumes that, given a pressure ratio and an initial volume flow, regardless of the initial condition of the steam, the stages designed will be similar in construction and will have essentially the same efficiency. A corollary of this assumption is that the same group of stages operating under other initial conditions but with the same pressure ratio will have the same efficiency. A turbine operating with various throttle flows typifies this condition and indicates the importance of this corollary.

The basic efficiency factors and efficiency corrections are re-evaluated in the light of more recent experience. The efficiency-calcualtion method given has been adjusted carefully to show a true comparison between machines of different types, sizes, steam conditions, reheat and non-reheat, etc. Partial-load performance and extended and refined procedures are introduced. The level of performance obtained by use of this method is judged to be the highest justifiable for prediction purposes at the present state of the art.

Based upon the performance-calculation method presented in this paper, relative heat-rate curves have been prepared comparing the performance of various turbine-generator units at normal nameplate rating. A complete heat-balance diagram and an efficiency-calculation example are included illustrating the use of the method.

Effect of Internal Pressure on the Flexibility and Stress-Intensification Factors of Curved Pipe or Welding Elbows, by E. C. Rodabaugh, Assoc. Mem. ASME, and H. H. George, National Cylinder Gas Co., Louisville, Ky. 1956 ASME Semi-Annual Meeting paper No. **56—SA-50** (multilithographed; to be published in Trans. ASME; available to April 1, 1957).

USING strain-energy methods, this paper develops a theory establishing the flexibility and stresses due to in-plane and out-of-plane bending including the effect of internal pressure.

The authors feel that such a theory is of interest because the flexibility and stress-intensification factors presently applied in piping-flexibility analysis to account for the behavior of curved pipe in bending have been derived from theories and tests with no internal pressure. Pressure tends to reduce the effect of these factors but in smaller and relatively thick-wall piping, commonly used in the past, the effect is of a low order and may be neglected; in larger diameter, relatively thin-wall piping, the effect is pronounced and significant.

The theory is developed for both in-plane and out-of-plane bending. It is then shown that the complex theoretical formulas can be represented by comparatively simple formulas with adequate accuracy for purposes of practical piping stress analysis.

Extensive tests were conducted to compare the theoretical pressure effect with experimental results. In general, the theory and tests are in agreement. The fact that the tests and theory do not agree precisely is probably due in part to such experimental factors as nonuniform wall thickness and end effects. In addition, the theory itself is not precise. Agreement of theory and test is considered adequate for curved pipes which are extremely different dimensionally.

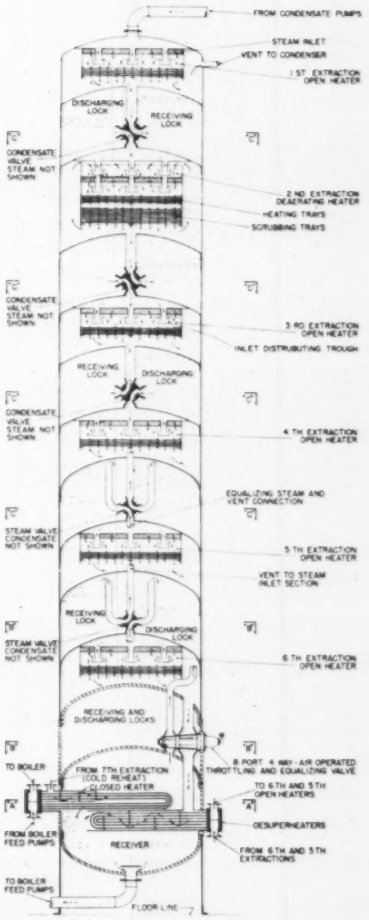
A New Way to Simplify the Steam-Power Plant, by H. A. Kuljian, Fellow ASME, and W. J. Fadden, Jr., Assoc. Mem. ASME, The Kuljian Corporation, Philadelphia, Pa. 1956 ASME Semi-Annual Meeting paper No. **56—SA-34** (multilithographed; to be published in Trans. ASME; available to April 1, 1957).

THIS paper presents a new approach to the problem of simplifying the installation and operation of steam-power plants. Two alternative methods are involved, both of which combine regenerative feedwater heaters in a single shell. One integrates the closed-type heat exchangers; the other employs a new method of using open-type heat exchangers with intermediate locks.

The type-K feedwater heater is basically a series of closed shell-and-tube-type heaters that have been combined in a single vertical shell and factory-built and tested as a single unit. The cycle efficiencies obtained by using this type of feedwater heater are equal to those obtained by using conventional regenerative cycles.

The new type-K-F feedwater heater uses standard tray-type open heaters and deaerating heater, as now manufactured, which are combined in a vertical tower. The heat rate for the regenerative cycle when using the K-F feedwater heater combined with a closed heater is better than that of the same cycle employing conventional closed heaters.

The basic concept of incorporating all the stages of feedwater heating in a single compact shell reduces costs by: (a) requiring greatly simplified piping; (b) reducing the number of engineering drawings; (c) reducing installation cost and time; and (d) reducing building volume, particularly valuable floor space. In the aggregate, these four economies indicate a total saving of from $10.00 to $15.00 per installed kw.


FROM CONDENSATE PUMPS
STEAM INLET
VENT TO CONDENSER
1 ST. EXTRACTION OPEN HEATER
DISCHARGING LOCK
RECEIVING LOCK
CONDENSATE VALVE STEAM NOT SHOWN
2 ND. EXTRACTION DEAERATING HEATER
HEATING TRAYS
SCRUBBING TRAYS
3 RD. EXTRACTION OPEN HEATER
INLET DISTRIBUTING TROUGH
4 TH EXTRACTION OPEN HEATER
EQUALIZING STEAM AND VENT CONNECTION
STEAM VALVE CONDENSATE NOT SHOWN
5 TH EXTRACTION OPEN HEATER
VENT TO STEAM INLET SECTION
6 TH EXTRACTION OPEN HEATER
RECEIVING AND DISCHARGING LOCKS
TO BOILER
FROM 7TH EXTRACTION (COLD REHEAT) CLOSED HEATER
8 PORT 4 WAY AIR OPERATED THROTTLING AND EQUALIZING VALVE
TO 6 TH AND 5 TH OPEN HEATERS
DESUPERHEATERS
FROM BOILER FEED PUMPS
RECEIVER
FROM 6 TH AND 5 TH EXTRACTIONS
TO BOILER FEED PUMPS
FLOOR LINE

K-F feedwater heater for 150,000-kw turbogenerator, 1800 psig, 1000 F

Metals Processing

Forces and Power Required to Turn Aluminum and Seven Alloys, by O. W. Boston, Fellow ASME, University of Michigan, Ann Arbor, Mich., and W. W. Gilbert, General Electric Company, Schenectady, N. Y. 1956 ASME Semi-Annual Meeting paper No. **56—SA-14** (in type; to be published in Trans. ASME; available to April 1, 1957).

TURNING tests on pure aluminum 1100-H14 and seven aluminum alloys were made to develop the formula for the tangential cutting force as a function of the material constant, the feed in inches per revolution, and the depth of cut in inches, when cutting dry, with a solid

high-speed steel tool ground for turning aluminum. Equations for each metal have been developed, and it is shown that the constants and exponents vary for each metal. Unit net power at the cutter has been computed for several sizes of cut for each metal and the values for a light cut and a medium-sized cut have been plotted against each of the mechanical properties of the materials. These data show that, knowing the Brinell hardness, the ultimate or yield strength of the metal, or the shear strength, values of the unit net horsepower at the cutter can be computed with considerable accuracy.

Comparative Machinability of B 1113—C 1213—C 1120 H.R.—C 1120 C.D. & C 1119 Steels, by H. L. Bryden, University of Connecticut, Storrs, Conn. 1956 ASME Semi-Annual Meeting paper No. **56—SA-26** (multilithographed; to be published in Trans. ASME; available to April 1, 1957).

A REPORT is presented on extensive machinability tests from which C 1119 steel indicated an average tool life six times greater than that of the best B 1113 and C 1213 steels and nine times the tool life of the average of seven varieties of B 1113 and C 1213 steels investigated. From the findings reported, a criticism and an explanation are offered as to why such an error in accepted machinability ratings should have gone so long undetected.

The criticism lies (1) in the technique of conducting tests wherein tool pressures are measured as an indication of machinability and (2) in that cutting tools are presumed to be exhausted on the basis of a predetermined amount of wear-land growth before complete destruction actually occurs. On the tests reported here, measured tool pressures failed to indicate what tool life would be when carried to ultimate failure, and in attempting to follow the wear land-growth technique an even less reliable relationship resulted. On the other hand, in the technique devised here, running to complete breakdown of the tool and ignoring tool pressures and land growths, an end point is reached beyond any dispute and no hypothesizing or projecting is necessary; thus any prospect of error is eliminated from this source.

From the many tests conducted and the manner in which failure occurred, a pattern of failure eventually took shape of one type of steel versus the other. The failure patterns resolved themselves into two distinct classes wherein the steels of the higher carbon content (C 1120—C 1119) showed a continually steady increase in tool wear almost from the outset but stood up a great deal longer than could have been anticipated when inspected microscopically at intervals during the life of the test. In the case of the steels of lower carbon content (B 1113—C 1213) microscopic inspection at similar intervals never revealed tool wear occurring as rapidly as in the case of higher-carbon-content steels; in the case of the lesser carbon steels unexpected failure occurred when tool wear-land growth was much less than that of tools continuing runs on the higher carbon variety. In short the tools wore out working the higher carbon steels and burned out unpredictably working the lesser carbon steels.

Based on the author's recommendations, many production parts produced on screw machines have been turned out using C 1119 steel at considerably elevated rates of production with enthusiastic reports of completely satisfactory results.

Effect of Cold Work on Elevated-Temperature Properties of Types 301, 305, and 310 Stainless Steels, by R. A. Lula, Assoc. Mem. ASME, A. J. Lena, and H. M. Johnson, Allegheny Ludlum Steel Corporation, Brackenridge, Pa. 1956 ASME Semi-Annual Meeting paper No. **56—SA-44** (multilithographed; to be published in Trans. ASME; available to April 1, 1957).

THIS paper is concerned with the results of an investigation on the effects of cold-working on the high-temperature properties of the austenitic stainless steels. The steels chosen for this work were Types 301, 305, and 310, with the major emphasis on Type 301.

The data presented show that it is possible to improve the elevated-temperature properties of the austenitic stainless steels by cold-working, providing the degree of cold work and conditions of exposure are not conducive to extensive recrystallization. Although the rupture strength begins to decrease with the initiation of recrystallization, improvement in strength is retained until the amount of recrystallization exceeds approximately 50 per cent.

An attempt was made in this study to determine why recrystallization exerts such a marked decrease in the stress-rupture properties of cold-rolled steels. It might be expected that restoration of an annealed condition through recrystallization would produce strengths equivalent to steels tested in the annealed condition. However, the data presented in this paper show that complete recrystallization in cold-worked materials results in properties which are definitely inferior to annealed materials. This fact indicates that the actual recrystallization process during testing, or structural modifications which are produced by recrystallization, may be detrimental to high-temperature strength. With respect to recrystallization, per se, Becker has suggested that accelerated creep should occur during recrystallization because of greater atomic mobility. This postulation has since been confirmed for a number of pure metals. In order to investigate this possible effect in cold-rolled stainless steels, samples of 305 and 310 were cold-rolled, recrystallized by aging at 1450 or 1475 F, and subsequently tested at 1200 or 1350 F.

For both materials, the rupture curves of samples recrystallized prior to testing are well below the annealed curves for all rupture lives. Furthermore, the 1000-hr rupture strength of samples which were recrystallized prior to testing are substantially the same as those with equivalent amounts of cold work which recrystallized during the test.

As a result of these experiments it is concluded that the structural modifications which occur as a result of recrystallization are harmful to high-temperature strength even if the recrystallization occurs during the test or prior to testing. These microstructural changes include a refinement in grain size and modification of carbide precipitation in all three steels and accelerated sigma formation during recrystallization in Type 310.

Force Relationships in the Machining of Low-Carbon Steels of Different Sulphur Contents, by F. W. Boulger, Mem. ASME, Battelle Memorial Institute, Columbus, Ohio, and H. E. Hartner, W. T. Lankford, Mem. ASME, and T. M. Garvey, United States Steel Corporation, Pittsburgh, Pa. 1956 ASME Semi-Annual Meeting paper No. **56—SA-21** (in type; to be published in Trans. ASME; available to April 1, 1957).

THE force relationships obtained in the machining of a series of low-carbon open-hearth steels containing various amounts of sulphur from 0.025 to 0.250 per cent were investigated in a constant-pressure lathe and in a conventional lathe. A wire-resistance, strain-gage dynamometer was used to measure the forces acting on a high-speed tool for various cutting conditions. In the constant-pressure test, sulphur additions increased the feed obtained with a given thrust load. The addition of sulphur reduced the forces acting on the tool for equivalent feeds in both test lathes.

Theoretical calculations disclosed that the effectiveness of increased sulphur contents results from decreased friction between the chip and the tool and from an accompanying reduction in strain dur-

ing chip formation. The decrease in friction and strain reduced the work required for removal of a unit volume of metal during machining. Shear stress was not a direct function of sulphur content, but generally decreased with feed. Results of conventional lathe tests generally corroborated those obtained in the constant-pressure lathe.

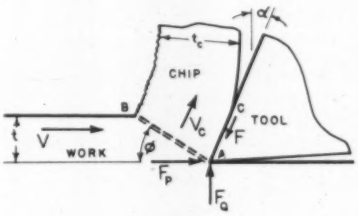
Leaded Steel and the Real Area of Contact in Metal Cutting, by M. C. Shaw, Mem. ASME, P. A. Smith, Mem. ASME, N. H. Cook, Massachusetts Institute of Technology, Cambridge, Mass., and E. G. Loewen, Mem. ASME, The Taft-Peirce Manufacturing Company, Woonsocket, R. I. 1956 ASME Semi-Annual Meeting paper No. **56—SA-37** (multilithographed; to be published in Trans. ASME; available to April 1, 1957).

THE action of lead in free-machining steel is discussed and the thickness of the layer of lead responsible for the improved lubrication between chip and tool is found to be extremely thin. Measurements made on the same steel with and without lead present enable the real area of contact between chip and tool to be estimated; this is found to be between one and two per cent of the apparent area of contact. The cutting characteristics of steel containing lead are compared with those for steel without lead as well as those for pure lead. It is found that the presence of lead makes effective fluids such as carbon tetrachloride less sensitive to an increase in cutting speed.

The Influence of Lead on Metal-Cutting Forces and Temperatures, by M. C. Shaw, Mem. ASME, P. A. Smith, Mem. ASME, and N. H. Cook, Massachusetts Institute of Technology, Cambridge, Mass., and E. G. Loewen, Mem. ASME, The Taft-Peirce Manufacturing Company, Woonsocket, R. I. 1956 ASME Semi-Annual Meeting paper No. **56—SA-36** (multilithographed; to be published in Trans. ASME; available to April 1, 1957).

THE effects of additions of lead and sulphur to steel upon tool-face friction F, cutting energy per unit volume u, and tool-face temperature $\bar{\theta}_t$, were investigated. By means of high-speed flash pictures of chips in the process of being formed, it was found that lead was effective in decreasing chip thickness at all speeds, but particularly at high speeds. Sulphur on the other hand was found most effective in this regard at tool temperatures (speeds) below about 900 F.

It was found that certain cutting fluids (principally cutting oils) interfered with the action of lead and sulphur, and fluids that are normally effective on ordinary steels may give poorer results than air upon steels containing lead or sulphur. In all cases, leaded steels were found to give lower values of F, u, and $\bar{\theta}_t$ than comparable nonleaded steels, and the improvement due to lead was far greater than could be achieved from cutting fluids at speeds of 150 fpm and above. The paper



Conditions at point of cutting tool during continuous cutting

ends with a note of warning that the results on F, u, and $\bar{\theta}_t$ cannot be used to predict tool life directly, and an example is presented which illustrates this point.

Instruments and Regulators

On the Dynamics of Pneumatic-Transmission Lines, by C. P. Rohmann, Assoc. Mem. ASME, and E. C. Grogan, Minneapolis-Honeywell Regulator Company, Philadelphia, Pa. 1956 ASME Semi-Annual Meeting paper No. **56—SA-1** (in type; to be published in Trans. ASME; available to April 1, 1957).

AN ANALYSIS of pneumatic-transmission tubing dynamics based on a system of evenly distributed fixed parameters is presented. The driving-point impedance and the output-input frequency response of pneumatic tubing are derived from the frequency-response approach with small signals. Both calculated and experimental results are plotted for selected lengths of tubing. The correlation between calculated and test results for frequency response with amplitudes of ±5 per cent of conventional full-scale signal (3–15 psig) or less is good. The relations obtained are very useful in determining the effects of output loads on pneumatic-device dynamics and the limitations imposed on process control by various-length pneumatic transmission lines.

The analysis presented in this paper is linearized to a form selected for convenience in engineering computation of the dynamics of complete pneumatic systems. Vector notation is used and the pneumatic parameters of resistance, capacitance, and inertance introduced, corresponding to the analogous electrical quantities of resistance, capacitance, and inductance. Pressure is made analogous to voltage, and volumetric flow rate corresponds to current. By this approach the considerable body of information on electric transmission lines now in the literature is made available for analysis of pneumatic transmission.

Analysis and Design of a Servomotor Operating on High-Pressure Compressed Gas, by Gerhard Reethof, Mem. ASME, Vickers, Inc., Detroit, Mich. 1956 ASME Semi-Annual Meeting paper No. **56—SA-20** (in type; to be published in Trans. ASME; available to April 1, 1957).

THE analysis, design, and development of a high-performance gas servomechanism suitable for aircraft and missile applications are described. The system is illustrated schematically.

The flow valve is supplied with a high-pressure gas from a constant-pressure gas-power source. The power-control valve consists of two upstream orifices of fixed area and two downstream orifices with differentially variable areas. The control pressures in the chambers between the upstream and downstream orifices are piped to each side of the fluid motor. In this instance the fluid motor consists of two single-acting, self-lubricating pistons which, through two spherical-ended connecting rods, apply a torque to the rocker arm. The rocker arm can be connected to the load by means of a splined shaft. The position of the output member is measured by a linear differential transformer which delivers an a-c signal. This signal is rectified in a keyed demodulator and fed back to the adding circuit of the forward-loop d-c amplifier.

The push-pull output stage of the amplifier supplies the polarizing currents and differentially varying signal currents to the two coils of the E-style electromagnetic valve actuator. The small motion of the plugs on the rotor of the valve actuator controls the flow and pressure conditions in the ram-type motor. An I-beam flexure-pivot mounting between rotor and stator insures frictionless motion of the rotor and maintains correct spacing of the air gaps. Since the magnetic fields produce a statically unstable valve actuator, a leaf spring is mounted on the stator and connected to the rotor by wire links. A constant tension in the wire links prevents backlash in the motion of the rotor. The desired high speed of response of the complete control system is obtained by feeding back a signal proportional to the velocity of the output member through an amplifier with an adjustable gain.

Design parameters were obtained from the results of an analog-computer design study. The predicted transient response agrees very well with the experimentally derived rise time of 4 millisec.

A Graphical Method for the Analysis of Piecewise Linear Control Systems, With Particular Application to Relay Controls, by R. H. Macmillan, Mem. ASME, University of Cambridge, Cambridge, Eng. 1956 ASME Semi-Annual Meeting paper No. **56—SA-17** (in type; to be published in Trans. ASME; available to April 1, 1957).

A GRAPHICAL method is described for the analysis of piecewise linear control systems. By means of it both transient and steady oscillations can be studied. After the "characteristic curves" of a system have been computed and plotted, it is shown that the effects of dead-zone solid friction, backlash, and various lead devices are easily taken into account, without further computation. The method is illustrated by a more detailed examination of the behavior of relay controls, and a few of the charts obtained by the method are given.

The approach used is to obtain an exact solution of the equations of motion over linear sections; the displacement and velocity (and, where necessary, higher derivatives of the motion) at the beginning of each section are then equated to those at the end of the preceding section.

A pair of characteristic curves is thus derived for the system. One curve relates the velocity at the moment when the displacement is zero to the displacement when the velocity is next zero, i.e., the maximum subsequent displacement; the other characteristic curve relates the initial maximum displacement to the velocity when the displacement is next zero. Each curve thus relates a velocity to a displacement, as does a phase plane trajectory, but the two quantities do not occur simultaneously as in such a trajectory.

By applying simple graphical procedures to these characteristic curves, it is possible to obtain the magnitudes of successive maxima and the time intervals between them and the zeros during any free oscillation. These points which are precisely determined may be called the "salient points" of the response. The special case in which the conditions at the end of a cycle are the same as they were initially is that of self-sustained oscillation. In this way, performance charts can be derived which are made to be of rather general application by using dimensionless variables.

Management

The Selection of Technical Managers, by A. Pemberton Johnson, Mem. ASME, Newark College of Engineering, Newark, N. J. 1956 ASME Semi-Annual Meeting paper No. **56—SA-10** (multilithographed; available to April 1, 1957).

A SCIENTIFIC approach is suggested for a problem which the author believes will become increasingly critical during the next 10 years—the selection of technical managers, who must possess both technical know-how and managerial skill. The approach involves (1) a critical-function analysis of the key duties to be performed, (2) study of the management climate surrounding the position, and (3) finding out which man under consideration has best demonstrated his ability to perform the key duties and be happy in the management climate involved.

It is suggested that, for any position, the functions which are carried out may be put into categories according to whether they deal primarily with ideas, things, economics, or men. In dealing with functions which are concerned with ideas, distinction is made according to whose ideas are being worked with—whether, for example, they are primarily ideas and/or new developments gleaned from technical publications, from other engineers, from nonengineers, or whether they are creations of one's own mind. These distinctions are important because otherwise a good technical specialist unwittingly may be removed from a situation in which he was successful because be dealt largely with his own ideas and with things and then placed in a technical-managerial position in which he deals primarily with other technical men, with their ideas, and with economics. Unless such a man has in some earlier position experienced the personnel problems, the crises, the compromises, the frustrations, and the unrelenting pressures which are so often a part of a manager's work, he may not in the least be prepared for his new duties. Beyond these considerations, it is important to determine how much he may be called upon to write letters, memoranda, and reports, to speak in small conference groups or before large groups, and whether these will be technical or nontechnical groups, or both.

A position description, if properly done, makes rather clear the management climate of the position. This particular "climate" is conceived as more than the process by which key decisions are made. It includes, among other matters, the rapidity with which successive changes in function, organization structure, objectives, and personnel are introduced, the care with which members of the technical and of the nontechnical staff are prepared for impending changes, the atmosphere of willingness or of unwillingness to undertake a calculated risk, the extent of the upward as well as of the downward flow of information and ideas through management channels, the tolerance of mistakes made in spite of reasonable care and good intentions, and the stimulation of new ideas or the lack of that stimulation.

In meeting the shortage of technical-management ability, the author feels that only by fostering interest in management positions among young engineers will there be enough prospective technical managers at hand to make possible even moderately effective selection. He recommends a systematic long-term program for the self-development of young technical men toward management responsibilities, and the systematic try-out and evaluation of the men in positions of increasing responsibility for the work of other people and for technical matters.

Availability List of Unpublished ASME Papers

A NUMBER of papers and reports were presented at ASME Meetings which were not preprinted or published. Manuscript copies of these papers are on file for reference purposes in the Engineering Societies Library, 29 West 39th Street, New York 18, N. Y. Photostatic copies of these unpublished papers may be secured from the library at the rate of 45 cents per page. The following papers recently have been placed on file in the Engineering Societies Library:

1955 Annual Meeting

A Progress Report on the Development of the General Motors Aerotrain, by B. B. Brownell and W. H. Harvey

Wood Particle Board—A Contemporary Material, by F. Domotor

Plastics in Transportation, by K. K. Fligor

A Basic Approach to Progressive Mechanization, by J. F. Mahan

Materials Strength Properties for the Modern Aircraft Structures Designer, by D. A. Shinn

How To Train Engineers for Manufacturing, by R. T. Weiser

Where Are We Now and Where Are We Going? by A. Zeitlin

1956 Spring Meeting

Power Requirements for Sawing Redwood Cants With Seven-Foot-Diameter Bandmill, by M. H. Mater

Natural Gas for the Pacific Northwest, by F. A. Hough and J. F. Bell

Tungsten Carbide Tools for Woodworking Industries, by R. V. Reynolds

1956 Semi-Annual Meeting

Properties and Applications of Marlex 50 Ethylene Polymer, by R. Vernon Jones, M. W. Davidson, and P. J. Boeke

Weather Aging of Colored Styrene Plastics, by H. C. Wood, J. R. Taylor, and R. J. Bourke

1956 Metals Engineering-AWS Conference

Carbon Migration in Welded Joints at Elevated Temperatures and Its Effect on Certain Mechanical Properties, by R. J. Christoffel and R. M. Curran

Development of a Ferritic-Austenitic Weld Joint for Steam Plant Application, by J. T. Tucker, Jr., and F. Eberle

Some Considerations in the Welding of Austenitic Chromium-Nickel Stainless Steels, by R. D. Wylie and O. R. Carpenter

1956 Aviation Conference

A Stabilized Platform to Mount on a Nonrigid Airship Base, by A. W. Williams

1956 Machine Design Conference

Evolution of the Iron Hand, by R. H. Melvin

1956 EIC-ASME Meeting

2,000,000 Kw Reheat Boiler Design for the Hydroelectric Power Commission of Ontario, Richard L. Hearn Station Boiler No. 5, by F. W. Cranston and M. G. Ireland

ASME Transactions

for September, 1956

THE September, 1956, issue of the Transactions of the ASME, which is the *Journal of Applied Mechanics* (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

Technical Papers

Bending of a Semicircular Plate, by D. F. Muster and M. A. Sadowsky. (56—APM-7)

Stress Solutions for an Infinite Plate With Triangular Inlay, by R. M. Evan-Iwanowski. (56—APM-4)

On Stresses and Deflections of Rectangular Beams, by B. A. Boley and I. S. Tolins. (56—APM-1)

Orthogonally Stiffened Plates, by W. H. Hoppmann, 2nd, N. J. Huffington, Jr., and L. S. Magness. (56—APM-11)

On the Strength of Thin-Walled Cylinders, by G. D. Galletly and R. Bart. (56—APM-9)

Buckling of Rectangular Plates, by P. Shuleshko. (56—APM-20)

On Role of Extension in Flexural Vibrations of Rings, by L. L. Philipson. (56—APM-2)

Wave Propagation in Ring Springs, by E. H. Lee and A. J. Wang. (56—APM-5)

On the Theory of the Acceleration Damper, by Carl Grubin. (56—APM-10)

Vibration of a Certain System, by D. C. Johnson and R. E. D. Bishop. (56—APM-16)

Effect of Spring Mass on Contact-Accelerometer Responses, by T. H. Lin. (56—APM-3)

Time-Dependent Tangent Modulus Applied to Column Creep Buckling, by R. L. Carlson. (56—APM-13)

An Elastoplastic Thermal-Stress Analysis of a Free Plate, by Jerome Weiner. (56—APM-6)

On the Carrying Capacity of Redundant Structures, by E. F. Masur and K. P. Milbradt. (56—APM-8)

The Propagation of Fatigue Cracks, by A. K. Head. (56—APM-15)

Impact With Finite Acceleration Time of Elastic Beams, by R. C. Alverson. (56—APM-14)

Determination of a Viscoelastic Model, by D. R. Bland and E. H. Lee. (56—APM-26)

Analysis of Slip Damping, by L. E. Goodman and J. K. Klumpp. (55—A-80)

Flexural Vibrations of Rectangular Plates, by R. D. Mindlin, A. Schacknow, and H. Deresiewicz. (55—A-78)

Momentum Diffusion From a Slot Jet, by A. S. Weinstein, J. A. Osterle, and W. Forstall. (55—A-60)

Studies on Plastic Flow of Anisotropic Metals, by L. W. Hu. (55—A-79)

Method for Calculating Stress-Concentration Factors, by M. Hetényi and T. D. Liu. (55—A-81)

Critical Thickness of Surface Film in Boundary Lubrication, by I-Ming Feng and C. M. Chang. (55—A-84)

Plastic Twisting of Thick-Walled Ring Sectors, by W. Freiberger and W. Prager. (55—A-85)

Design Data and Methods

Deflection of Straight Beam Subjected to Unsymmetrical Bending, by J. C. Levy.

Rational Analysis of Heat-Exchanger Tube-Sheet Stresses, by Yi-Yuan Yu.

Brief Notes

Theory of Fatigue Fracture, by A. Ali Kheiralla

On the Gage Factor of SR-4 Type Strain Gages, by G. C. Kuczynski.

On Buckling of Sandwich Cylinders, by A. C. Eringen.

The Complex-Variable Approach to Stress Singularities—II, by M. L. Williams.

Stress-Concentration Factors in Bending of Shafts, by H. Ōkubo and K. Takai.

The Bauschinger Effect on Columns, by P. C. Paris.

Discussion

Discussion on previously published papers by P. G. Hodge, Jr.; F. F. Ehrich; P. S. Theocaris; M. M. Frocht and P. D. Flynn; Yi-Yuan Yu; N. J. Huffington, Jr.; G. Horvay, C. E. Linkous, and J. S. Born; and L. W. Hu and N. H. Triner.

Book Reviews

ASME Papers Order Form

Copies of ASME technical papers digested this month are available in pamphlet form. Please order only by paper *number;* otherwise the order will be returned. Orders should be addressed to the ASME Order Department, 29 W. 39th St., New York 18, N. Y. Papers are priced at 25 cents each to members; 50 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons distributed annually to members, or coupons which may be purchased from the Society. The coupons, in lots of ten, are $2 to members; $4 to nonmembers.

Note: No digests are made of ASME papers published in full or condensed form in other sections of MECHANICAL ENGINEERING.

Copies of all ASME publications are on file in the Engineering Societies Library and are indexed by the Engineering Index, Inc., both at 29 West 39th Street, New York, N. Y.

ASME Transactions and the *Journal of Applied Mechanics* are on file in the main public libraries of large industrial cities and in the technical libraries of engineering colleges having ASME Student Branches.

ASME Order Department
29 W. 39th St.
New York 18, N. Y.

Date.....

Please send me the papers indicated by the following circled numbers:

56—APM-4	56—APM-40
56—APM-5	56—APM-41
56—APM-7	56—SA-1
56—APM-11	56—SA-10
56—APM-12	56—SA-14
56—APM-14	56—SA-15
56—APM-15	56—SA-16
56—APM-16	56—SA-17
56—APM-17	56—SA-20
56—APM-18	56—SA-21
56—APM-19	56—SA-26
56—APM-20	56—SA-34
56—APM-21	56—SA-36
56—APM-25	56—SA-37
56—APM-26	56—SA-44
56—APM-28	56—SA-45
56—APM-30	56—SA-50
56—APM-33	56—SA-51
56—APM-35	56—SA-52
56—APM-36	56—SA-59
56—APM-37	56—SA-66
56—APM-38	56—SA-69

Name.....

Address.....

City.....State.....

☐ Remittance enclosed ☐ Bill me

☐ ASME Mem. ☐ Nonmem.

Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

Cermets

Comment by W. L. Havekotte[1]

ASTM, C-21 recently formed a new subcommittee on cermets, the subject of this paper.[2] The purpose of the group will be to standardize the tests on these materials. However, one of the first items on the agenda will be to define the term "cermet." While I have always thought of a cermet as material to be used for high-temperature applications (above 1500 F), maybe the following materials, to name but three, also should be considered in this class:

WC bonded with Co (cutting tools)
Al_2O_3 bonded with Al (SAP aluminum)
Cr_3C_2 bonded with Ni (wear applications)

The author's definition of a cermet, therefore, is very timely and helpful.

In his oral presentation, the author stated: "If the American manufacturers were as free with their data on cermets as were the Austrians, the author wouldn't have to use the Austrian data." To this statement I would like to say that a tremendous number of technical papers, company bulletins, and unclassified government reports have been published giving data on American-produced cermets. Within the past two to three years, I have accumulated a pile of government reports on cermets for high-temperature service which would stack at least 2 ft high. These reports are only a small percentage of the available data on cermets.

During the past four years, the writer's company has spent considerable time and effort developing TiC-base cermets. The work included the TiC grades mentioned by the author. Incidentally, this company has the exclusive United States rights for the manufacture and sale of the grades mentioned by the author, and I believe that our designations are of interest. FS-8 and WZ-12B, FS-9 and WZ-12C, and FS-12 and WZ-12D are identical.

The author's stress-rupture data for 1740 F will be somewhat confusing since most of the comparable data in this

[1] Manager, Cermet Research, Firth Sterling Inc., Pittsburgh, Pa.

[2] "Cermets—for High-Temperature Service," by J. T. Norton, MECHANICAL ENGINEERING, vol. 78, April, 1956, pp. 319–322.

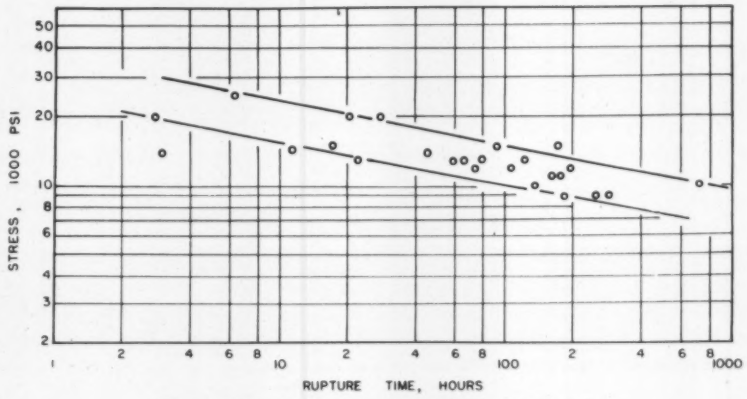


Fig. 1 Stress-rupture strengths of FS-8 at 1800 F

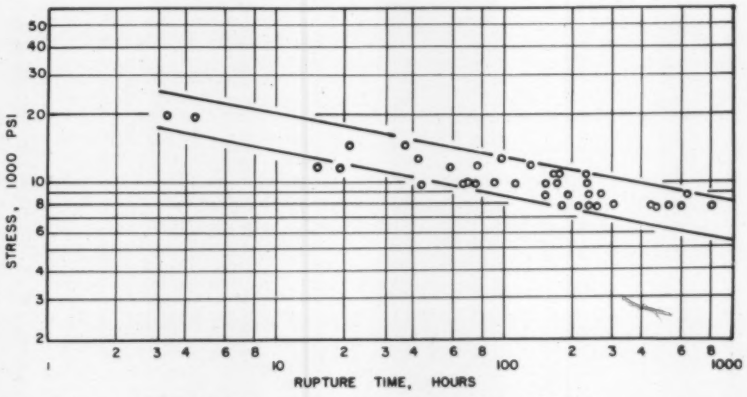


Fig. 2 Stress-rupture strengths of FS-9 at 1800 F

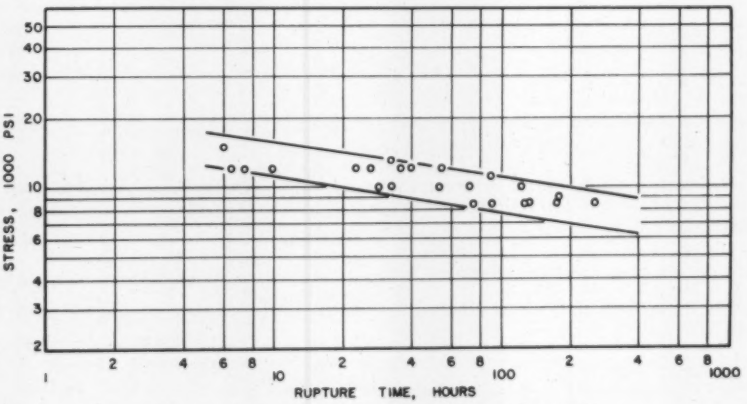


Fig. 3 Stress-rupture strengths of FS-12 at 1800 F

country are for 1800 F. The three accompanying curves show the stress-rupture strengths for FS-8, FS-9, and FS-12 at 1800 F. The median 100-hr strengths were 12,500 psi for FS-8, 10,900 psi for FS-9, and 9300 psi for FS-12. Even though the author's data are for tests at 1740 F I believe his values are definitely too high.

The author's impact data may be misleading since subsize specimens were used and the results were in inch-pounds. Using unnotched Charpy bars (0.394 × 0.394 × 2.165 in.), the impact resistance for these three grades increased from about 2.5 to 7.0 ft-lb at room temperature as the binder content increased from 35 to 65 per cent. X-40 has an impact resistance of 44 ft-lb.

The Hoover Commission

To the Editor:

I DISAGREE seriously with Mr. John H. Davidson's complaint[3] that MECHANICAL ENGINEERING is using too much space "for such articles as the one entitled 'Some Major Findings of the Hoover Commission.'" On the contrary, I would like to see more such articles, and MECHANICAL ENGINEERING is just the type of technical magazine in which they should appear. It is not the only official magazine of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. The Transactions and the *Journal of Applied Mechanics* are two others, and they are set up for the exclusive presentation and discussion of the highly technical work reported to and by the Society.

I am sure that I speak for a greater number of engineers who believe that engineering is not all science, not all graphical data, not all drafting work, and not all construction. There are many engineers who realize that they should take part in community activities of a serious nature, that engineers should be elected to school boards and town government, and that engineers even should be elected to Congress more and more than they seem to be at present. Engineers formerly have not enjoyed the prestige accorded to doctors, lawyers, clergymen, and other businessmen of the community. They have been too wrapped up in their slide rules, handbooks, and designs, to be interested in civic responsibility. But increasingly they are being made to realize their folly and complacency, and many of them now are making their voices heard in many ways and positions not connected with engineering, all across the country, and even around the world.

Magazines such as MECHANICAL ENGINEERING have contained articles dealing with the humanities, with various phases of education, with professional development, with aspects of community service, and every major meeting of the Society sponsors papers written on these subjects.

How could engineers serve on a school board if they were not acquainted with the broad, not just the technical, aspects of education? How could an engineer serve in Congress without reading and understanding the various reports dealing with the reorganization of the Executive and other branches of the Government? It is a tribute to Dean Hollister's ability and leadership that he was selected to serve on the Hoover Commission as an engineer. And MECHANICAL ENGINEERING was the logical periodical to which he would be likely to submit his report on the major findings of the Commission. The very last paragraph in his report should hit home hard into the minds of engineers who think government and politics are not the business of engineers.

"None of the improvements recommended by the Commission will come about if the citizens of the country sit complacently on the side lines. We have the biggest and most expensive Government in the world. We are on trial to see whether we can make it effective without its becoming our master."

I sincerely hope that Mr. Davidson, and other engineers like him, will reconsider his complaint. He surely must recognize that engineering is now so intertwined with government, politics, economics, and other aspects of society in general, that engineers need considerable background in many other fields in order to do a competent job even in the field of engineering.

Technical men working in a very narrow field often can improve that field by going outside it periodically "to see what the rest of the world is like." When engineers are required to stand up in Congress, or in a town meeting, or in a courtroom, to meet and contend with their colleagues and equals in other highly complex fields, and do so successfully, then they are not only being engineers in the truest sense of the word, but also demonstrating the courage, the understanding, and the humility of men concerned simply with the needs of their fellow beings.

Clifford B. Haughton, Jr.[4]

[3] "The Hoover Commission," comment by John H. Davidson, MECHANICAL ENGINEERING, July, 1956, vol. 78, p. 660.

[4] Senior Development Engineer, Lycoming Division, Avco Manufacturing Corporation, Stratford, Conn. Mem. ASME.

To the Editor:

IN THE July issue of MECHANICAL ENGINEERING there appeared a comment by Mr. J. H. Davidson criticizing the use of space in MECHANICAL ENGINEERING for Mr. Hollister's article in the February issue.

I do not agree with Mr. Davidson's comment and believe that articles of this type should appear more frequently than they do. Factual data concerning the major issues affecting our American way of life should be publicized when and where they will be read by good American citizens.

We must strive not only to be good engineers but also must be good citizens of this great country of ours. We very definitely have civic responsibilities which can best be fulfilled by being well informed. What better way is there to keep us reminded of those civic responsibilities, than to have an occasional article placed in the midst of a magazine which most of us read from cover to cover. I feel confident that engineers, with their better than average powers of analysis, will be able to separate the wheat from the chaff.

Perhaps I could agree with Mr. Davidson that this type of article might be left out of the Transactions, but MECHANICAL ENGINEERING is, to me at least, more of a news magazine that is doing a commendable job of keeping the mechanical engineer of the ASME informed of things that directly affect his welfare as an engineer as well as a citizen. An occasional reminder to break away our thinking from the technical aspects of our contribution to society and to impress upon us that we also have duties as citizens certainly deserves space in any well-integrated society organ.

Furthermore, I strongly recommend that each member of ASME turn again to page 150 of the February issue and review the facts which have been so ably presented to us by Dean Hollister.

Harold E. Stickle.[5]

Choosing a College

To the Editor:

THE list of 150 engineering schools approved by ECPD is unsatisfactory. Those schools just meeting the minimum standards are lumped with the best in the country. The young man seeking guidance as to the best schools his abilities might command cannot get it. His parents and high-school counsellor

[5] Steam Stations, Boston Edison Company, Boston, Mass. Mem. ASME.

usually cannot help him. Society members counseling our future engineers are instructed to omit specific answers as to the best schools. They are told to reply that the selection depends on many personal preferences such as urban vs. rural location, large vs. small school, comparative cost of tuition and board, distance from home, and other factors. We avoid answering the most important question—what are the best schools?

A young man about to spend $6000–$8000 for four years of engineering education is vitally interested in knowing whether he is going to get the best the country has to offer. He does not want such education rated as Grade B in getting a job when he graduates or if he goes on to graduate work for a master's or doctor's degree. The rating of Grade B can affect his success in getting a job with an outstanding employer or add a year to the time required to get a graduate degree. But in spite of the requirements of our Code of Ethics, official guidance is denied him.

ECPD until 1955 refrained from any important use of quantitative criteria in determining an accredited school. This last year, however, in order to meet the recommendations of the American Society for Engineering Education as to what constituted an approved engineering education, ECPD has specified the number of years to be devoted to mathematics, science, mechanics, and the humanities. These additional criteria are not enough. What results in quality of graduates are our engineering schools getting? What per cent of the alumni are in Who's Who in Engineering, 1954? How many male awardees per 1000 graduates have shown future scholarship or scientific promise in the winning of some fellowship, scholarship, or prize of a graduate level in open competition, or the attainment of a PhD or its equivalent (e.g., the ScD)? Other criteria can be added, such as the number of master's and doctor's degrees awarded in five years as a per cent of the corresponding enrollment. Individuals are judged by results. Why should an engineering school be exempt from the same standard? The main point, however, is to separate from the present approved list those schools that do not measure up to the best in the country. Then our future engineers can select those schools best fitted to their educational attainments and personal qualities with assurance that they are not wasting a year or so in a Class B school. Their welfare is our most valuable asset.

The future of this country depends on the efficient use of our engineering talent. We cannot compete with Russia in the number of our engineers but we can compete if we so desire on the basis of the efficient use of our best students.

Gregory M. Dexter.[6]

Age Limit for Engineers?

To the Editor:

FROM time to time MECHANICAL ENGINEERING has published articles and comments on the shortage of engineers that has developed during the past few years since the Korean War.

This inspires me to ask: How can any corporation head claim that there is really a shortage when his company refuses to hire engineers who are over 45 and lays them off when they reach 65?

Although a few have abandoned this practice, it is still a very general rule among large companies.

Might I suggest that those corporation heads who say so much about shortages of engineers show their honesty by first dropping their age bars?

Archibald Black.[7]

Books Received in Library

AIRCRAFT PRODUCTION METHODS. By Gordon B. Ashmead. First edition, 1956. The Chilton Company, Philadelphia, Pa. 293 p., $5^7/_8 \times 9^1/_4$ in., bound. $7.50. A description of the latest methods of production in typical aircraft factories, from the preparation of the master plaster pattern to final inspection. The book includes chapters on sheet-metal-forming processes; heat and surface treatment; plastics, optical, and assembly tooling; welding; and machining. Over 300 photographs are used to illustrate the text.

ASM REVIEW OF METAL LITERATURE. Volume 12, 1955. Marjorie R. Hyslop, editor. Published 1956 by the American Society for Metals, Cleveland, Ohio. 732 p., $6 \times 9^1/_4$ in., bound. $15. Similar in coverage and form of presentation to previous volumes, this twelfth annual compilation of annotated references from *Metals Review* provides a convenient guide to world metallurgical literature. The references are grouped into broad classes on the basis of process or property and are indexed by authors and subjects.

BASIC ENGINEERING SCIENCES, SOLUTION TO PROBLEMS. By William Glendinning. Fourth edition, 1956. Available through author, 5123 Bell Boulevard, Bayside, N. Y. 122 p., $8^1/_2 \times 10^7/_8$ in., paper. $3. Detailed solutions to selected problems from Part 2 of the N. Y. State professional engineering examinations given over the past ten years through February, 1956. The fields covered include mechanics, machine design, hydraulics, thermodynamics, and electricity. Illustrative diagrams have been used wherever they are necessary.

BCAS HANDBOOK OF PNEUMATIC EQUIPMENT. Second edition, 1955. Compiled and published by the British Compressed Air Society, London, England. 194 p., $5^1/_2 \times 9$ in., bound. 20s. A guide to pneumatic equipment available from British manufacturers, comprised of concise, nontechnical descriptions of the structural characteristics, performance, and applications of compressors, foundry molding machines, rock drills, pumps, cement guns, vibrators, etc.

CAREERS IN ENGINEERING. By Lowell O. Stewart. Third edition, 1956. The Iowa State College Press, Press Building, Ames, Iowa. 105 p., 6 × 9 in., paper. $1.25. This booklet gives information on the nature of the engineering profession; the aptitudes, interests, and personality necessary for the study of engineering; factors that determine success in college and after; and the engineer's fields of work. The engineering fields are considered from three points of view: by degree-granting departments of universities, by industries employing engineers, and by function such as design, construction, research, etc. Aids to counselors and teachers and other books on the profession are listed in an appendix.

CONTRIBUTION A L'ÉTUDE DE L'ÉFFET DE PAROI EN ÉCOULEMENT PLAN INCOMPRESSIBLE. By Jacques Barbieux. 1955, Publications Scientifiques et Techniques, No. 304, Ministère de L'Air, Paris, France. 247 p., $7 \times 10^6/_8$ in., paper. 2800 Fr. An extensive and detailed analysis of the effect of the confining walls on incompressible plane flow. The specific field of application chiefly concerned is wind-tunnel research and the aerodynamic effects involved. The author concludes his study with a comparison of experience with theory.

CONTRIBUTION A L'ÉTUDE DES MILIEUX POREUX. By Mladen M. Boreli. 1955, Publications Scientifiques et Techniques, No. 305, Ministère de L'Air, Paris. 129 p., $7^1/_8 \times 10^5/_8$ in., paper 1700 Fr. In this study of the flow of homogeneous liquids through porous media the author describes the results of his experimental research and discusses in considerable detail the action under various conditions. For the general case he also discusses the representation by electric analogy. The problems involved occur in many fields of engineering particularly where the movement of fluid through the soil is concerned.

EINGRIFFSFLÄCHE BEIM ZYLINDERSCHNECKENTRIEB UND IHRE KONSTRUKTION. Volume 17,

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

[6] Consulting Industrial Engineer, Scarsdale, N. Y. Life Mem. ASME.

[7] Professional Engineer, Garden City, N. Y.

Schriftenreihe Antriebstechnik. By Robert Jakobi. 1956, Friedrich Vieweg and Sohn, Braunschweig, Germany. 86 p., $6^3/_8 \times 9^1/_8$ in., paper. 17.80 DM. A theoretical study of the properties of the contact surface in cylindrical worm gearing. Results are summarized in nine design specifications and sixteen propositions which will allow a rapid graphical determination of points on the contact surfaces of any type of cylindrical-worm-gear drive. The graphical representations are collected in an appendix at the back.

GRUNDZÜGE DER TENSORRECHNUNG IN ANALYTISCHER DARSTELLUNG. Part 3, Anwendungen in Physik und Technik. By Adalbert Duschek and August Hochrainer. 1955, Springer-Verlag, Vienna, Austria. 250 p., $5^3/_8 \times 8^1/_8$ in., paper. $5.70. This third volume of a standard German text on tensor analysis discusses, with considerable illustrative detail, applications in the fields of physics and engineering, particularly in mechanics, hydrodynamics, heat, and electromagnetism.

PANEL DISCUSSION ON PYROMETRIC PRACTICES. (ASTM Special Technical Publication No. 178.) Published by the American Society for Testing Materials, Philadelphia, Pa. 41 p., 6×9 in., paper. $1.50. This publication includes an introductory discussion of ASTM recommended practices for conducting tension tests at elevated temperatures, one paper on thermocouple immersion errors, and two papers on creep and rupture-test pyrometry.

ASME Boiler and Pressure Vessel Code

Interpretations

THE Boiler and Pressure Vessel Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N.Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting June 22, 1956, and approved by the Board on September 6, 1956.)

Annulment of Cases

The following cases are to be annulled:

CASE NOS.	REASONS FOR ANNULMENT
1175	Essence of Case is now included in Section VIII.
1187	Essence of Case is now included in Par. UG-47(c).

Case No. 1223

(Interpretation of Par. P-108)

Inquiry: May austenitic stainless steel materials conforming to one of the grades of specifications acceptable in Section I be used in welded construction without a stress-relief heat-treatment after welding as required by Par. P-108? Are any special inspection requirements necessary?

Reply: (a) It is the opinion of the Committee that thermal heat treatment, including stress-relief, of austenitic stainless-steel weldments is neither required nor prohibited; therefore, the joints of all parts of austenitic stainless steel, regardless of thickness, welded under the provisions of Section I are exempt from the stress-relieving requirements of Par. P-108.

(b) All weldments over $^3/_4$ in. thick shall be examined for the detection of cracks by the fluid penetrant method. This examination shall be made following heat treatment if heat-treatment is performed.

(c) Weldments required to be radiographed by the requirements of Par. P-102(h) shall be radiographed following heat-treatment if heat-treatment is performed.

CAUTIONARY NOTE: In recognition of controversial opinion relative to the effect of thermal treatment of austenitic stainless steels, mandatory requirements for such have been omitted. Service experience is too limited to permit comparison between the relative safety of as-welded and thermally treated, including stress-relieved, austenitic steel weldments, particularly in thick sections. It is suggested that reference be made to the Non-Mandatory Appendix of Part UHA of the 1956 Section VIII.

Case No. 1224

(Special Ruling)

Inquiry: Neither Section I nor Section VIII of the ASME Boiler and Pressure Vessel Code as now written precisely covers pressure vessels that are an integral part of a nuclear installation. Under what rules shall they be constructed?

Reply: The Committee recognizes that in the design of nuclear installations, requirements will differ from those of conventional boilers and pressure vessels.

1—It is the opinion of the Committee that vessels that are an integral part of nuclear installations built in accordance with the requirements of the ASME Boiler and Pressure Vessel Code as modified or defined in this and subsequent cases, meet the intent of the Code, and each vessel shall be marked as required by the section to which it is built including the appropriate Code Symbol. In addition the words, "Case No. —" shall appear on the Data Report.

2—All vessels that are an integral part of nuclear installations shall be constructed in accordance either with the requirements of Section I or with the requirements of Section VIII for vessels that are to contain lethal substances.

3—It is intended that jurisdiction over piping external to vessels shall terminate at:

(1) The first circumferential joint for welding end connections; or,

(2) The face of the first flange in bolted flange connections; or,

(3) The first threaded joint in that type of connection.

Case No. 1225

(Special Ruling)

Inquiry: Various safety requirements of Section I and Section VIII would actually be hazardous if applied literally to the design of nuclear reactors. May these requirements be modified for reactors of the pressurized water and boiling water types?

Reply: It is the opinion of the Committee that nuclear reactors of the pressurized-water and boiling-water-type will meet the intent of the Code and shall be marked in accordance with Case No. 1224 if the following provisions are met:

(1) Totally enclosed pop-type safety or relief valves shall be provided, but need not be directly attached to the vessel provided there is no valve between the vessel and the safety or relief valve; also they shall be installed as close as is practical to the vessel. They shall not discharge to the atmosphere, and shall discharge to a suitable system designed to condense any vapors. At least two safety or relief valves are required and the total capacity shall be sufficient to insure that the design pressure is not exceeded by more than 10 per cent.

(2) Direct reading pressure gages are not required. At least two independent devices for determining pressure are required and these shall not be dependent on the same external source of energy.

(3) Inspection openings, gage glasses, water columns, and gage cocks are not required.

Case No. 1226

(Special Ruling)

Inquiry: May containment vessels* for nuclear reactor installations be built under Section VIII, Code for Unfired Pressure Vessels without stress relieving as specified in Par. UW-2(a)?

Reply: It is the opinion of the Committee that these containment vessels fall under the category of those containing lethal substances but still may be built without stress relieving provided the following requirements are met:

(1) Plates and forgings of containment vessels exposed to the elements (not inside a heated enclosure) shall conform to specifications SA-300 for plates and SA-350 for forgings. These and other materials and the construction shall meet the impact test requirements of Par. UG-84 at a temperature not less than 30 F below the lowest recorded ambient temperature of the area in which the containment vessel is to be erected, except that the lowest test temperature may be assumed to be —50 F for any part in the United States.

(2) Welding procedures and operators shall be qualified in accordance with Section IX.

(3) All doors, nozzles, and opening frames shall be preassembled into shell plate and stress relieved as complete assemblies for welding into the shell. Also, special consideration should be given to make the design of the reinforcement for large openings as strong as the shell (see Par. UA-7).

(4) The thickness of shell and head plates shall not exceed that for which stress relief is required in accordance with Par. UCS-56.

(5) All longitudinal and circumferential joints shall be of the double-welded butt type and shall be fully radiographed in accordance with Par. UW-51. All welds on doors, nozzles, and openings frames, and all welds that cannot be radiographed shall be examined for cracks by magnetic particle or fluid penetrant method of inspection.

(6) The Case number shall appear on the Manufacturers' Data Report Form.

* *Containment Vessels* are those outer vessels which enclose the primary reactor vessel and/or portions of the primary coolant circuit. The containment vessels are not normally pressurized and are built to contain the lethal radioactive substances that may be released in case of an accident or failure of any part of the primary reactor vessel or coolant circuit.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code...

As NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board of Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

Material Specifications, 1956

The Boiler and Pressure Vessel Committee has approved adding to Section II the following new specification:

SA-395-55T, Specification for Cast Nodular Iron for Pressure Containing Parts for Use at Elevated Temperature.

Delete SA-107—Specification for Hot-Rolled Carbon-Steel Bars.

Care of Power Boilers, 1954

PAR. C3.303 Revise to read:

Where possible, portable lamps, 32 volts or less, with current supplied from transformers or batteries should be used. Only approved, properly guarded extension cords shall be used with waterproof fittings and all connections shall be made exterior to the boiler. Light bulbs shall be equipped with explosion-proof guards. Sockets, lamp guards, and fittings shall be properly grounded.

Unfired Pressure Vessels, 1956

PAR. UA-6(a) Revise to read:

M_0 = the total moment determined as in Par. UA-49 except that for heads of the type shown in Fig. UA-6(d) a moment $H_r h_r$ (which may add or subtract) shall be included in addition to the moment $H_D h_D$ where:

H_r = radial component of the membrane load in the spherical segment = H_D cot β_1, pounds, acting at the intersection of the inside of the flange ring with the centerline of the dished cover thickness,

h_r = lever arm of force H_r about centroid of flange ring, in.,

H_D = axial component of the membrane load in the spherical segment, pounds, acting at the inside of the flange ring,

h_D = radial distance from the bolt circle to the inside of the flange ring, inches.

Fig. UA-6(d) Delete the following note:

Assumed point see UA-49(a)(1)

Welding Qualifications, 1956

TABLE Q-11.1 Add the following specification under P-Number 1:

Material Spec.	Psi Min Tensile	Type of Material
SA-306 Grade 45	45000	Carbon steel bar
Grade 50	50000	Carbon steel bar
Grade 55	55000	Carbon steel bar
Grade 60	60000	Carbon steel bar

TABLE Q-11.2 Add the following footnote as note 6 to read:

Note 6: Electrodes E-6024 and E-6027 of Spec. SA-233 may be considered in the same F-1 classification as EXX 20 and EXX 30 of SA-233.

TABLE Q-13 Revise lines 2 and 3 under the heading "Thickness, t, of Test Plate or Pipe as Welded," to read:

Over $^3/_8$ but less than $^3/_4$ in. (Note 4)
$^3/_4$ in. and over

TABLE QN-13 Revise lines 2 and 3 under the heading "Thickness of Test Plate or Pipe as Welded In." to read:

Over $^3/_8$ in. but less than $^3/_4$ in. (Note 3)
$^3/_4$ in. and over

TABLES Q-24 and QN-24 Revise lines 2, 3, and 4 under the heading "Thickness, t, of Test Plate, or Pipe as Welded, in." to read:

Over $^3/_8$ but less than $^3/_4$
Over $^3/_8$ but less than $^3/_4$
$^3/_4$ in. and over

PAR. Q-24(c) Add the following words to the end of the second sentence:

...and Q-13.2(b).

Add the following words at the beginning of the fourth sentence:

When the plate box is used, the...

PAR. QN-24(c) Add the following words to the end of the second sentence:

...and QN-13.2(b).

Add the following words at the beginning of the fourth sentence:

When the plate box is used, the...

ASME News

With Notes on Society Activities and Events

E. S. Newman, *News Editor*

Free Exchange of Knowledge—the Path to the Future, Theme of 1956 ASME Annual Meeting in New York City

Meeting program, with facilities at two hotels, offers hundreds of significant technical papers, inspection trips, social events, a women's program, and ASME Power Show at N. Y. Coliseum

With "Free Exchange of Knowledge—the Path to the Future" as the keynote, plans for the 1956 Annual Meeting of The American Society of Mechanical Engineers, to be held November 25–30, at the Statler and the Sheraton-McAlpin Hotels, New York, N. Y., are well launched. More than 100 technical sessions are scheduled on the five-day program which offers a vast variety of activities to those who will attend the technical as well as the general sessions, the social events, and the inspection trips.

The meeting will open officially at 2:00 p.m. on Sunday, November 25. The early arrivals will be able to register for the meeting at either the registration desk located in the Ballroom Foyer of the Hotel Statler or the one on the 24th floor of the Sheraton-McAlpin Hotel. The Metropolitan Section of the Woman's Auxiliary to the ASME has planned an Early Bird Party at the National Arts Club, situated in charming Gramercy Square, to follow the Sunday registration period.

Feature Events

The feature events of the meeting will commence with the President's Luncheon on Monday with an address by ASME President Joseph W. Barker. On Monday evening, the Nuclear Engineering Dinner will have a prominent authority in this field as speaker. Tuesday noon will be marked by a number of Division luncheons, including Management, Fuels, Heat Transfer, and the National Junior Committee. The Honorable Ralph E. Flanders, past-president and Hon. Mem. ASME, U. S. Senator from Vermont, has accepted an invitation to deliver the main address at the Management Luncheon. The Tuesday dinners include the Applied Mechanics Dinner and the Hydraulic Old Timers' Dinner. Another outstanding event on Tuesday evening will be the Annual Award Dinner of the American Institute of Consulting Engineers which will be conducted in the Cert Room of the Waldorf-Astoria Hotel.

The Members and Students Luncheon will be held on Wednesday rather than Thursday, as was the custom in recent years. On this occasion the principal speaker will be J. William Jakobson, who won the Student Paper Competition sponsored by the Old Guard Committee. Also Wednesday at noon a joint luncheon will be conducted by the ASME Aviation Division and the American Rocket Society. This luncheon will feature a general report on the Vanguard Project.

The Annual Banquet, the occasion for the presentation of the new officers, distinguished members of the engineering profession, and recipients of honors and awards, will be held on Wednesday evening.

Thursday's high lights feature a Wood Industries Luncheon and a luncheon held as part of the International Conference on Fatigue of Metals. In the evening the Power Test Codes Committee will hold a dinner and the American Rocket Society Honors Night Dinner will be held in the Henry Hudson Hotel.

The closing social event of the meeting, on Friday, will be the Textile Engineering Luncheon.

Registration Schedule

Sunday, November 25, 2:00 p.m. to 5:00 p.m.
Monday, November 26, 8:00 a.m. to 8:00 p.m.
Tuesday, November 27, 8:00 a.m. to 8:00 p.m.
Wednesday, November 28, 8:00 a.m. to 3:00 p.m.
Thursday, November 29, 8:00 a.m. to 8:00 p.m.
Friday, November 30, 8:00 a.m. to 3:00 p.m.

Inspection Trips

The Inspection Trips Committee announced the following tentative list of inspection trips:

Monday, November 26: Chas. Pfizer Company, Inc., manufacturers of pharmaceuticals

Tuesday, November 27: Consolidated Edison Company of New York Astoria generating plant, and/or the Air Cargo Terminal at New York International Airport

Wednesday, November 28: Ford Motor Company, Mahwah, N. J., and/or American Export Lines USS *Constitution*

Thursday, November 29: Lincoln Tunnel third tube, presently under construction, and/or Medallic Art Company, manufacturers of emblems, medals, plaques, and so on.

Additional details will be announced in the advance program for the meeting which will be distributed to the general membership of the Society on October 15.

College Reunions

Numerous colleges reunions again have been planned to be held during the Annual Meeting

in order to provide many members of the Society the opportunity of joining their former classmates and fellow engineers at small dinners or conversation. However at press time only the following reunions are listed: University of California, Carnegie Institute of Technology, Cornell University, Iowa State College, Ohio State University, Stevens Institute of Technology, and many others, no doubt, to be added in the advance program.

Other Meetings

As reported in the September issue of MECHANICAL ENGINEERING, pages 875–876, the International Conference on Fatigue of Metals will be held November 28–30 as part of the ASME Annual Meeting. For technical program details consult last month's issue.

Information on the annual meeting program of the American Rocket Society, an affiliate of ASME, being held at the Henry Hudson Hotel, concurrently with the ASME Annual Meeting, will be available in the advance program.

Tentative Program

All ASME technical sessions will be held in either the Hotel Statler or Sheraton-McAlpin. The Nuclear Engineering, Heat Transfer, Fuels, Furnace Performance Factors, and Wood Industries programs will all be scheduled in the Sheraton-McAlpin. The rest will be in the Statler. The ARS sessions will be held in the Henry Hudson Hotel.

The tentative program follows:

MONDAY, NOVEMBER 26

8:00 a.m.

Registration

9:30 a.m.

Applied Mechanics (I-A)

Some Mixed Boundary-Value Problems of the Semi-Infinite Strip, by *G. Horvay* and *Mrs. J. S. Born*, General Electric Co. (Paper No. 56—A-54)

Dislocation Over a Bounded-Plane Area in an Infinite Solid, by *L. Rongved*, Bell Telephone Laboratories, Inc. (Paper No. 56—A-53)

Beams of Uniform Strength Subjected to Uniformly Distributed Loading, by *W. A. Gross*, Bell Telephone Laboratories, Inc., and *J. P. Li*, Ford Motor Co. (Paper No. 56—A-9)

A Mixed Boundary-Value Problem of Elasticity With Parabolic Boundary,[2] by *Gunadhar Paria*, Indian Institute of Technology, Kharagpur, India (Paper No. 56—A-24)

9:30 a.m.

Nuclear Engineering (I)—Power (I)

Design Progress in the Major Atomic Power Plants—Part 1

The Yankee Atomic-Electric Plant, by *G. A. Reed*, New England Power Co.; *R. J. Creagan*, Westinghouse Electric Corp.; and *Walter Woodman*, Stone & Webster Engineering Corp. (Paper No. 56—A-166)

The Dresden Nuclear Power Station, by *J. R. Wolcott, V. A. Elliott, G. M. Roy, E. P. Peabody*, and *G. Sege*, General Electric Co. (Paper No. 56—A-169)

Enrico Fermi Atomic Power Plant, by *J. F. Anderson*, Power Reactor Development Co.; *W. N. McDaniels*, Atomic Power Development Associates, and *C. M. Heidel*, Detroit Edison Co. (Paper No. 56—A-168)

9:30 a.m.

Aviation (I)—Materials Handling (I)

Developing the Air-Cargo Industry—Part 1

Airfreight-Sales Development, by *T. J. Harris*, American Airlines, Inc. (Paper No. 56—A-173)

[1] Paper not available—see box on this page.
[2] Not presented orally.

Order for Technical Papers

ONLY copies of *numbered* ASME papers will be available October 1. Some of these papers may not be available in time to permit your receiving them in advance of the meeting. Your order will be mailed only when the complete order can be filled unless you request that all papers available ten days before the meeting be mailed at that time. Please order only by paper *number*; otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the meeting.

Copies of ASME papers may be obtained by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 25 cents each to members; 50 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons, or coupons which may be purchased from the Society. The coupons in lots of ten are $2 for members; $4 for nonmembers.

Copies of unnumbered papers, listed in the program, *are not available* because the review of these manuscripts had not been completed when the program went to press. The author's name and paper number will appear with paper title in the final program (final program available only at meeting) as well as the issue of MECHANICAL ENGINEERING containing an account of the meeting, if the paper has been recommended for publication in pamphlet form.

Air-Cargo Terminal Design and Location, by *J. R. Wiley*, The Port of New York Authority (Paper No. 56—A-174)

9:30 a.m.

Instruments and Regulators (I)

Signal Stabilization of a Control System, by *Rufus Oldenburger*, Purdue University (Paper No. 56-A-92)

The Phase-Space Method for Analysis of Nonlinear Control Systems, by *Y. H. Ku*, University of Pennsylvania (Paper No. 56—A-103)

Design Bases for Cascade-Type Positional Servomechanisms, by *Sidney Lees*, Massachusetts Institute of Technology, and *T. C. Blaschke*, Sperry Gyroscope Co. (Paper No. 56—A-105)

9:30 a.m.

Heat Transfer (I)

The Viscosity of Five Gases: A Re-Evaluation, by *Joseph Kestin* and *Hung-En Wang*, Brown University (Paper No. 56—A-72)

Transient Heat-Flow Determination of the Thermal Properties of Clay, by *E. B. Penrod*, University of Kentucky, and *G. T. Prison*, Carrier Corp. (Paper No. 56—A-91)

The Determination of the Equation of State From Wave-Front Observations, by *E. F. Lype*, General Electric Co. (Paper No. 56—A-129)

9:30 a.m.

Hydraulic (I)

Fluid Mechanics

Pressure Drop for Parallel Flow Through Rod Bundles, by *B. W. Le Tourneau, R. E. Grimble*, and *J. E. Zerbe*, Westinghouse Electric Corp. (Paper No. 56—A-134)

Losses in Pipe and Fittings, by *R. J. S. Pigott*, Pittsburgh, Pa. (Paper No. 56—A-63)

Resistance Coefficients for Laminar and Turbulent Flow Through One-Half-Inch Valves and Fittings[1,2]

9:30 a.m.

Machine Design (I)—Lubrication—Applied Mechanics (I-B)

Use of Digital Computers in Machine Design

Graphical Versus Computer Techniques for Mechanism Analysis, by *L. F. Welanets*, The Johns Hopkins University (Paper No. 56—A-48)

The Use of High-Speed Computers in the Design and Appraisal of Helical Gears, by *L. G. Johnson*, General Motors Corp. (Paper No. 56—A-142)

Application of Digital Computers to Bearing Design, by *Beno Sternlicht* and *F. J. Maginniss*, General Electric Co. (Paper No. 56—A-73)

9:30 a.m.

Effect of Temperature on the Properties of Metals

Basis for the Design and Retirement of Petroleum-Heater Tubes[1]

The Effect of Elastic Follow-Up and Restressing on the Service Life of Chromium Molybdenum Vanadium Bolts at High Temperature[1]

Influence of Heat Treatment on the 1000 and 1050 F Properties of Steam Pipe Made in Japan and Germany From 1.25 Cr-0.50 Mo and 2.25 Cr-1.0 Mo Steels[1]

Progress Report of Steam-Power Panel Project SP2 on Elevated Temperature Properties of Cast Iron[1]

9:30 a.m.

Metals Engineering (I)

The Nonhomogeneous Yielding of Steel Cylinders; Part 1—Mild Steel, by *M. C. Steele* and *L. C. Eichberger*, University of Illinois (Paper No. 56—A-39)

Delayed-Yield Time Effect in Mild Steel Under Oscillatory Axial Loads, by *R. O. Belsheim*, Naval Research Laboratory (Paper No. 56—A-108)

Effects of Neutron Radiation Upon the Tensile and Impact Properties of ASTM-A302-B Steel, by *E. E. Baldwin*, General Electric Co. (Paper No. 56—A-107)

9:30 a.m.

Air-Pollution Controls—Fuels (I)

Experimental Investigation of Critical Design Factors for Vane-Type Cyclone Collectors[1]

Carbon Monoxide Boiler Pays Off in Fuel Savings and Produces Zero Carbon Monoxide[1]

12:15 p.m.

President's Luncheon

Address by: *Joseph W. Barker*, ASME President

2:30 p.m.

Applied Mechanics (II-A)

On the Stress Distribution at the Base of a Crack, by *M. L. Williams*, California Institute of Technology (Paper No. 56—A-16)

A Theory of Adhesive Scarf Joints, by *J. L. Lubkin*, American Machine & Foundry Co. (Paper No. 56—A-52)

Effect of Stress on Creep at High Temperatures, by *H. Laks*, General Electric Co., *C. D. Wiseman, O. D. Sherby*, and *J. E. Dorn*, University of California (Paper No. 56—A-55)

The Effect of a Circular Hole on the Pure Twist of an Infinite Strip,[2] by *Osamu Tamate*, Tohoku University, Sendai, Japan (Paper No. 56—A-17)

2:30 p.m.

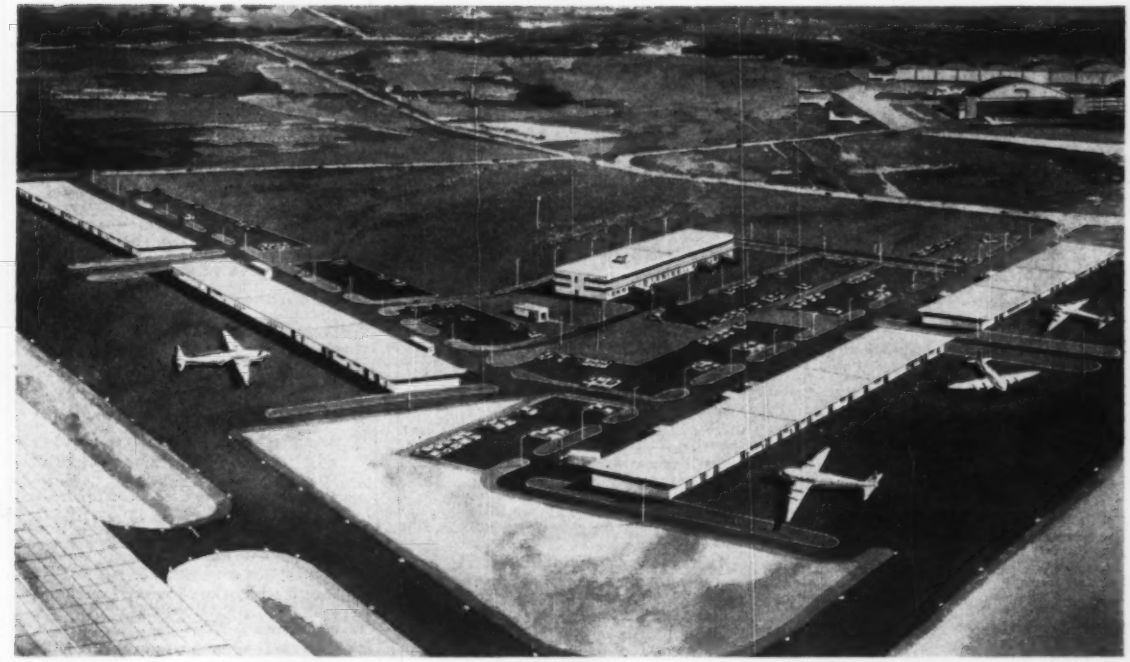
Nuclear Engineering (II)—Power (II)

Design Progress in the Major Atomic Power Plants—Part 2

The Consolidated Edison Indian Point Nuclear Power Plant, by *G. R. Milne*, Consolidated Edison Company of New York, and *F. R. Ward*, The Babcock & Wilcox Co. (Paper No. 56—A-167)

Proposed 75,000-Kw Sodium-Graphite Reactor for the Consumers' Public-Power District of Nebraska, by *F. C. Gronemeyer*, North American Aviation, Inc. (Paper No. 56—A-171)

The P.A.R. Homogeneous Reactor Project, by *W. E. Johnson* and *D. H. Fox*, Westinghouse Electric Corp.; and *Stanley Townsend*, Pennsylvania Power & Light Co. (Paper No. 56—A-170)



Artist's rendering shows 80-acre air-cargo center at New York International Airport, featured among the inspection trips to be conducted during the 1956 ASME Annual meeting, November 25–30, at the Statler and Sheraton-McAlpin Hotels, New York, N. Y. Built by the Port of New York Authority, it cost $5,500,000. Center comprises four one-story cargo buildings, each 80 × 750 ft, and a two-story cargo-service building with a floor area of 69,000 sq ft.

2:30 p.m.

Aviation (II)—Materials Handling (II)

Developing the Air-Cargo Industry—Part 2

Materials-Handling Equipment and Techniques for Loading and Unloading All-Cargo Aircraft[1]

All-Cargo Aircraft Requirements for Efficient Ground Operation, by *W. H. Arata, Jr.*, Fairchild Aircraft Division (Paper No. 56—A-172)

2:30 p.m.

Instruments and Regulators (II)

Technical Memoranda Originating Through the Dynamic Systems Committee

Dynamic Response of a Top Temperature-Control System, by *D. M. Boyd*, Universal Oil Products Co. (Paper No. 56—A-158([A])

A New Maximum-Power Criterion for Certain Hydraulic-Control Valves, by *R. P. Heintz*, National Water Lift Co. (Paper No. 56—A-158 ([B])

Minimizing Undesirable Oscillations in Certain Two-Stage Electrohydraulic Control Valves, by *R. P. Heintz*, National Water Lift Co. (Paper No. 56—A-158([C])

Effect of an End Chamber on the Surge Frequency in a Hydraulic Conduit, by *F. D. Ezekiel*, Massachusetts Institute of Technology (Paper No. 56—A-158([D])

Frequency of a Preloaded System, by *C. Desmond Pengelley*, The Glenn L. Martin Co. (Paper No. 56—A-158([E])

A New Method for Analog Correlation, by *J. B. Reswick* and *J. E. Roberts*, Massachusetts Institute of Technology (Paper No. 56—A-158([F])

Gearbox Layout (Logarithmic Spiral), by *J. C. Sweeney*, Naval Air Development Center (Paper No. 56—A-158([G])

2:30 p.m.

Heat Transfer (II)

A New Finite Difference Technique for Solution of the Heat-Conduction Equation, Especially Near Surfaces With Convective Heat, by *H. G. Elrod, Jr.*, Columbia University (Paper No. 56—A-112)

Design of Supersonic Expansion Nozzles and Calculation of Isentropic Exponent for Chemically Reacting Gases, by *Rudolph Edse*, Ohio State University (Paper No. 56—A-106)

Transient Air Temperatures in a Duct, by *S. E. Rea*, Boeing Airplane Co., and *C. M. Ablow*, Stanford Research Institute (Paper No. 56—A-70)

2:30 p.m.

Hydraulic (II-A)

Fluid Mechanics of Turbomachinery

Skewed Boundary-Layer Flow Near the End Walls of a Compressor Cascade, by *R. W. Moore, Jr.*, Arthur D. Little Co., and *D. L. Richardson*, United Aircraft Corp. (Paper No. 56—A-131)

An Investigation of the End-Wall Boundary Layer of a Turbine-Nozzle Cascade, by *J. R. Turner*, North American Aviation, Inc. (Paper No. 56—A-132)

2:30 p.m.

Hydraulic (II-B)

Fluid-Power Systems

Compensation of Steady-State Flow Forces in Spool-Type Hydraulic Valves, by *R. N. Clark*, Minneapolis-Honeywell Regulator Co. (Paper No. 56—A-121)

The Effects of Back Pressure on Hydraulic Oil-Control Valves, by *J. J. Pippenger*, Double A Products Co. (56—A-148)

2:30 p.m.

Machine Design (II)—Applied Mechanics (II-B)—Metals Engineering (II-A)

Fatigue

Effect of Complex Stress-Time Cycles on the Fatigue Properties of Metals, by *W. L. Starkey* and *S. M. Marco*, The Ohio State University (Paper No. 56—A-1)

A Million-Pound High-Speed Dynamic Fatigue-Test Machine, by *Gregory Flynn, Jr.* and *A. F. Underwood*, General Motors Corp. (Paper No. 56—A-145)

Fatigue of Metals Under Combinations of Stresses, by *W. N. Findley*, Brown University (Paper No. 56—A-74)

2:30 p.m.

Petroleum (I)

The Application of Gas-Liquid Cyclones in Oil Refining, by *J. R. J. van Dongen*, N.V. de Bataafsche Petroleum Mij., The Hague, Netherlands, and *A. J. ter Linden*, Technological University of Delft, Delft, Netherlands (Paper No. 56—A-61)

Concurrent Flow of Air, Gas-Oil, and Water in a Horizontal Pipe, by *D. P. Sobocinski*, University of Kansas, and *R. L. Huntington*, University of Oklahoma (Paper No. 56—A-60)

2:30 p.m.

Metals Engineering (II-B)

The Flow and Fracture of Nodular Cast Iron, by *W. R. Clough*, Union Carbide & Carbon Corp., and *M. E. Shank*, Massachusetts Institute of Technology (Paper No. 56—A-110)

The Influence of Repeated Bending Stress Loads on Biaxial Residual Stresses in Shot-Peened Plates, by *T. M. Elsesser*, University of Illinois (Paper No. 56—A-109)

Creep Characteristics of Type 347 Stainless Steel at 1050 and 1100 F in Tension and Compression, by *Michael J. Manjoine*, Westinghouse Research Laboratories (Paper No. 56—A-40)

4:30 p.m.

Tea Dance

4:45 p.m.

Business Meeting

6:00 p.m.

Nuclear Engineering Dinner

8:00 p.m.

Applied Mechanics (III)

On Radial Deflections of a Cylinder Subjected to Equal and Opposite Concentrated Radial Loads, by *S. W. Yuan* and *L. Ting*, Polytechnic Institute of Brooklyn (Paper No. 56—A-64)

A Numerical Procedure for Calculating the Large Deflections of Straight and Curved Beams, by *A. E. Seames* and *H. D. Conway*, Cornell University (Paper No. 56—A-38)

A Simple Procedure for Improved Accuracy in the Resistor-Network Solution of Laplace's and Poisson's Equations, by *H. G. Landau*, Columbia University (Paper No. 56—A-13)

[1] Paper not available—see box on page 972.

Official Notice
ASME Business Meeting

THE Annual Business Meeting of the members of The American Society of Mechanical Engineers will be held on Monday afternoon, Nov. 26, 1956, at 4:45 p.m. at the Hotel Statler, New York, N. Y., as part of the Annual Meeting of the Society.

Members are urged to attend.

8:00 p.m.

Power (III)—Metals Engineering (III)

Material Failures

The Generator-Rotor-Fracture Problem—Progress Report[1]

Progress Report on Turbine Rotors in Symposium Form[1]

8:00 p.m.

Instruments and Regulators (III)—Aviation (III)

Pilot Response Utilization—A Study in Human-Response Dynamics, by *A. J. Cacioppo*, Goodyear Aircraft Corp. (Paper No. 56—A-149)

Measurement of Integration of Acceleration in Inertial Navigation, by *J. M. Slater*, North American Aviation, Inc. To be presented by *D. E. Wilcox*, North American Aviation, Inc. (Paper No. 56—A-160)

8:00 p.m.

Materials Handling (III)

Fork-Truck Stability—A Study in Moments, by *R. W. Puder, W. H. Bogar,* and *R. D. Jay*, E. I. du Pont de Nemours & Co., Inc. (Paper No. 56—A-114)

Push-Button Carloading in a Palletized Brewery[1]

8:00 p.m.

Production Engineering (I)—Machine Design (III)

Ultrafinishing—A New High-Precision Lapping Process, by *T. G. Lewis, Jr.*, E. I. du Pont de Nemours & Co., Inc. (Paper No. 56—A-77)

Stress Distributions in Rotating Disks Subjected to Creep Including Effects of Variable Thickness and Temperature, by *A. M. Wahl*, Westinghouse Electric Corp. (Paper No. 56—A-162)

TUESDAY, NOVEMBER 27

8:00 a.m.

Registration

9:30 a.m.

Applied Mechanics (IV)

Longitudinal Impact of a Semi-Infinite Circular Elastic Bar, by *Richard Skalak*, Columbia University (Paper No. 56—A-37)

Response of Beams and Plates to Random Loads, by *A. Cemal Eringen*, Purdue University (Paper No. 56—A-5)

Some New Data on High-Speed Impact Phenomena, by *J. H. Huth* and *J. S. Thompson*, Rand Corp., and *M. E. Van Valkenburg*, University of Utah (Paper No. 56—A-15)

Experiments for the Determination of Transient Stress and Strain Distributions in Two-Dimensional Problems, by *A. J. Durelli* and *W. R. Riley*, Illinois Institute of Technology (Paper No. 56—A-11)

Forced Vibration of a Body on an Elastic Stratum,[2] by *G. B. Warburton*, University of Edinburgh, Edinburgh, Scotland (Paper No. 56—A-35)

9:30 a.m.

Management (I)—Production Engineering (II)—Education (I-A)

Concepts of Manager Development in Engineering Enterprises

First-Line Supervision—How Do They Spend Their Time?: Case Studies and a Program for Improvement, by *Jerome Underhill*, Merck & Company, Inc. (Paper No. 56—A-84)

Engineering as a Function of Management, by *J. A. Ritchey*, Purdue University (Paper No. 56—A-65)

Engineers Study Administration, by *K. C. Harder*, Department of the Navy (Paper No. 56—A-96)

9:30 a.m.

Fuels (II)—Power (IV)

Outlook for Fuels

Competition, Substitution, and Demands Among Fuels[1]

The Interrelationship Between Technological Advance and the Economic Growth of the Nuclear Power Industry in the United States[1]

Trends and Prospects in the Coal Industry[1]

9:30 a.m.

Aviation (IV)—Materials Handling (IV)

Panel Discussion: Airport Planning

Airport and Design Requirements: *John P. Veerling*, The Port of New York Authority

Passenger-Terminal Functional Design: *Byers Rathbone*, Trans World Airlines

Cargo-Building Functional Design: *Charles Dworshak*, Slick Airways.

Airport Equipment: *R. H. Davies*, Clark Equipment Co.

Airline-Customer Representative: *George S. Schairer*, Boeing Aircraft Co.

9:30 a.m.

Instruments and Regulators (IV)—Mechanical Pressure Elements

Diaphragm-Technology Review and Proposed Research[1]

Diaphragm Characteristics and Design[1]

Pressure-Flow Characteristics of Pneumatic Valves, by *F. D. Ezekiel* and *J. L. Shearer*, Massachusetts Institute of Technology (Paper No. 56—A-104)

9:30 a.m.

Heat Transfer (III)—Gas Turbine Power (I)

Heat Transfer to Laminar Boundary Layers With Variable Free-Stream Velocity, by *R. A. Seban*, University of California (Paper No. 56—A-125)

Experimental Studies of Free-Convection Heat Transfer in a Vertical Tube With Uniform-Heat Flux, by *J. P. Hartnett*, University of Minnesota, and *W. E. Welsh* (Paper No. 56—A-113)

Heat-Transfer and Fluid-Flow Friction Characteristics of Woven-Screen and Crossed Rod Matrices, by *L. S. Tong*, Westinghouse Electric Corp., and *A. L. London*, Stanford University (Paper No. 56—A-124)

9:30 a.m.

Hydraulic (III-A)

Pumping Machinery

Development of the Boiler-Feed Pumps for a Super-Critical Pressure Steam-Power Station[1]

Jet-Pump Theory and Performance With Fluids of High Viscosity, by *R. G. Cunningham*, Shell Oil Company Research Laboratory (Paper No. 56—A-58)

An Experimental Study of Centrifugal Pump Impellers,[2] by *A. J. Acosta*, California Institute of Technology, and *R. D. Bowerman*, U. S. Industries Research & Development Corp. (Paper No. 56—A-41)

9:30 a.m.

Hydraulic (III-B)

Compressors

Equivalent Performance Parameters for Turboblowers and Compressors, by *Hunt Davis*, Worthington Corp. (Paper No. 56—A-122)

An Automatic, Spray Desuperheating, Closed System for Testing Compressors, by *C. A. Macaluso*, Worthington Corp. (Paper No. 56—A-153)

9:30 a.m.

Machine Design (IV)

Use of Optics in Machine Design

Accuracy Requirements of Graflex 70-mm Combat Camera Focusing System, by *N. B. Seebe*, Graflex, Inc. (Paper No. 56—A-147)

A Nonintermittent Film Projector—Problems in Design and Manufacture, by *Otto Wittel* and *D. G. Haefele*, Eastman Kodak Co. (Paper No. 56—A-67)

9:30 a.m.

Petroleum (II)

Apparent Frictional Forces on Clamping Elements as Used in the Oil Industry, by *E. I. Moser*, Schlumberger Well Surveying Corp., and *J. C. Wilhoit, Jr.*, Rice Institute (Paper No. 56—A-31)

Yesterday, Today, and Tomorrow—Pipeline Steels, by *A. B. Wilder* and *A. F. Aebersold*, United States Steel Corp. (Paper No. 56—A-97)

9:30 a.m.

Metal Processing (I)

Experimental and Theoretical Pressures and Velocity Fields for Various Lead Extrusions, by *E. G. Thomsen* and *J. Frisch*, University of California (Paper No. 56—A-45)

Cold Extrusion of Unalloyed Titanium, by *A. M. Sabroff, O. J. Huber,* and *P. D. Frost*, Battelle Memorial Institute (Paper No. 56—A-88)

9:30 a.m.

Education (I-B)—Junior (I)

Disintinguishing Characteristics of the Mechanical Engineer[1]

9:30 a.m.

American Rocket Society (I-A)

Solid Propellants

9:30 a.m.

American Rocket Society (I-B)

Space Law and Sociology

12:00 noon

American Rocket Society Luncheon

12:15 p.m.

Management Luncheon

Presider: *H. N. Muller, Jr.*, Westinghouse Electric Corp.

Address by: *Ralph E. Flanders*, past-president and Hon. Mem. ASME, U. S. Senator from Vermont

12:15 p.m.

Fuels Luncheon

Presider: *William S. Major*, Dravo Corporation

Speaker: *Clyde Williams*, Battelle Memorial Institute

Subject: **The "New Look" for Fuels and Power**

12:15 p.m.

Heat Transfer Luncheon

Presider: *Myron Tribus*, University of California

Speaker: *Peter Courvoisier*, Observatorium Davos, Davos, Switzerland

Subject: **The Utilization of Solar Energy**

12:15 p.m.

Junior Luncheon

2:30 p.m.

Applied Mechanics (V)

Vibration Modes of Stators of Induction Motors, by *E. Erdelyi* and *G. Horvay*, General Electric Co. (Paper No. 56—A-28)

Dependence of the Frequency Spectrum of a Circular Disk on Poisson's Ratio, by *R. L. Sharma*, Collins Radio Co. (Paper No. 56—A-10)

Min-Max Solutions for the Linear Mass-Spring System, by *Eugene Sevin*, Illinois Institute of Technology (Paper No. 56—A-26)

An Improvement of the Holzer Table Based on a Suggestion of Rayleigh's, by *S. H. Crandall*, Massachusetts Institute of Technology, and *W. Gilbert Strang*, Oxford University, Oxford, England (Paper No. 56—A-27)

The Synthesis of Four-Bar Mechanism by the Method of Components,[2] by *J. Hirschhorn*, New South Wales University of Technology, New South Wales, Australia (Paper No. 56—A-3)

2:30 p.m.

Management (II)—Production Engineering (III)—Machine Design (V)

Planning an Engineering Project

Engineering—Tooled for Action, by *J. E. Barbier*, Jones & Lamson Machine Co. (Paper No. 56—A-76)

Standards for Filing Engineering Drawings, by *Lester Gerber*, National Records Management Council, Inc. (Paper No. 56—A-93)

[1] Paper not available—see box on page 972.
[2] Not presented orally.

2:30 p.m.

Fuels (III)—Corrosion and Deposits From Combustion Gases (I)

Discussion of Dust Suppression in Coal Handling[1]

Evaluating Coals by Utilization Cost[1]

Low-Temperature Deposits and Corrosion in Boilers[1]

2:30 p.m.

Instruments and Regulators (V)

Method for Presenting the Response of Temperature Measuring Systems, by *Robert Looney*, Taylor Instrument Companies (Paper No. 56—A-102)

Responses of Temperature-Sensing-Element Analogs, by *G. A. Coon*, Taylor Instrument Companies (Paper No. 56—A-101)

2:30 p.m.

Gas Turbine Power (II)

A 40-Ft Personnel Boat With Gas-Turbine Propulsion—Engine-Installation Features and Operating Experience[1]

Air-and-Gas Duct System for the Gas-Turbine Vessel *John Sargeant*[1]

2:30 p.m.

Heat Transfer (IV)—Power (V)

The Effect of Condensate Reheat on Mean-Temperature Difference in Feedwater-Heater Subcooling Zones, by *K. A. Gardner*, Griscom-Russell Co. (Paper No. 56—A-69)

A Theoretical Analysis of Heat Transfer by Convection and Boiling, by *Yan Po Chang*, Taiwan College, Tainan, Taiwan, China (Paper No. 56—A-42)

Heat Transfer to Lead Bismuth in Turbulent Flow in an Annulus, by *R. A. Seban*, University of California, and *D. F. Casey*, North American Aviation (Paper No. 56—A-62)

2:30 p.m.

Hydraulic (IV-A)

Hydraulic Prime Movers

Symposium: Laboratory Testing of Hydraulic Turbine Models in Relation to Field Performance

W. J. Rheingans, Allis-Chalmers Manufacturing Co.

W. R. McNamee, Baldwin-Lima-Hamilton Corp.

R. S. Sproule, Dominion Engineering Works Ltd., Montreal, Que., Canada

B. L. VanderBoegh, Newport News Shipbuilding & Drydock Co.

G. Dugan Johnson, S. Morgan Smith Co.

2:30 p.m.

Hydraulic (IV-B)—Oil and Gas Power (I)

Compressors

The Design and Operation of an Electric Analog of a Reciprocating Compressor[1]

Investigation of the Interaction of Windage and Leakage Phenomena in a Centrifugal Compressor, by *Hisao Jimbo*, Showa Aircraft Industry Co., Ltd., Tokyo, Japan. To be presented by *W. A. Wilson*, Massachusetts Institute of Technology (Paper No. 56—A-47)

2:30 p.m.

Materials Handling (V)—Production Engineering (III-A)

Materials-Handling Methods in Packing Industry[1]

Materials Handling in Product Finishing, by *J. C. Somers*, Industrial Products Engineering Co. (Paper No. 56—A-150)

2:30 p.m.

Junior (II)—Education (II)

Addresses by: *Joseph W. Barker*, ASME President, and *Donald E. Jahncke*, Ford Motor Co.

2:30 p.m.

Metal Processing (II)

An Experimental Study on Chatter Vibrations in Grinding Operations, by *S Doi*, Nagoya University, Chikusa-Ku, Nagoya, Japan (Paper No. 56—A-6)

On the Basic Mechanics of the Grinding Process, by *M. E. Merchant* and *W. R. Backer*, The Cincinnati Milling Machine Co. (Paper No. 56—A-43)

[1] Paper not available—see box on page 972.

2:30 p.m.

American Rocket Society (II-A)

High-Temperature Materials

2:30 p.m.

American Rocket Society (II-B)

Combustion

6:00 p.m.

Applied Mechanics Dinner

6:30 p.m.

American Institute of Consulting Engineers Annual Awards Dinner

6:30 p.m.

Hydraulic Old Timers' Dinner

8:00 p.m.

Power (VI)

Supercritical Pressure

Engineering the Eddystone Plant for 5000-lb, 1200-deg Steam, by *J. H. Harlow*, Philadelphia Electric Co. (Paper No. 56—A-165)

The Eddystone Superpressure Unit, by *C. B. Campbell, C. C. Franck, Sr.*, and *J. C. Spahr*, Westinghouse Electric Corp. (Paper No. 56—A-156)

Engineering the Eddystone Steam Generator for 5000 Psig, 1200 F Steam, by *E. M. Powell*, Combustion Engineering, Inc. (Paper No. 56—A-164)

8:00 p.m.

Metal Processing (III)

Force Components, Chip Geometry, and Specific Cutting Energy in Orthogonal and Oblique Machining of SAE 1015 Steel, by *Dimitri Kececioglu*, Allis-Chalmers Manufacturing Co. (Paper No. 56—A-155)

Shear-Strain Rate in Metal Cutting and Its Effects on Shear-Flow Stress, by *Dimitri Kececioglu*, Allis-Chalmers Manufacturing Co. (Paper No. 56—A-154)

WEDNESDAY, NOVEMBER 28

8:00 a.m.

Registration

9:00 a.m.

International Conference on Fatigue of Metals (I)

Basic Studies

9:30 a.m.

Applied Mechanics (VI)

Buckling of Initially Imperfect Cylindrical Shells Subject to Torsion, by *W. A. Nash*, University of Florida (Paper No. 56—A-36)

General Instability of a Ring-Stiffened Circular Cylindrical Shell Under Hydrostatic Pressure, by *S. R. Bodner*, Brown University (Paper No. 56—A-30)

The Collapse Strength of Redundant Beams After Lateral Buckling, by *E. F. Masur*, University of Michigan and *K. P. Milbradt*, Illinois Institute of Technology (Paper No. 56—A-51)

Structural Damping of a Simple Built-Up Beam With Riveted Joints in Bending, by *T. H. H. Pian*, Massachusetts Institute of Technology (Paper No. 56—A-2)

9:30 a.m.

Power (VII)—Instruments and Regulators (VI)

Control Equipment and Computer Applications

The Information Center With Automatic Logger and Scanner at Neches Power Station of Gulf States Utilities[1]

System Operation With Fast-Response-Type Load-Control Equipment[1]

The Importance of Matching Steam Temperatures With Metal Temperatures During the Starting of Large Steam Turbines, by *R. L. Jackson, S. B. Coulter*, and *R. Sheppard*, General Electric Co. (Paper No. 56—A-177)

9:30 a.m.

Aviation (V)

Panel Discussion: Helicopters as Flying Cranes

Army Requirements for Helicopters as Material-Lifting Devices: *Meade Mitchell*, Army Transportation Corps

Requirements for Helicopters in Amphibious Operations: *Keith B. McCutcheon*, U. S. Marine Corps Development Center

Flying-Crane Requirements in Off-Shore Oil Drilling: *Lawrence Marsh*, Standard-Vacuum Oil Co.

The Helicopter Flying Crane—Its Present and Potential Performance: *Edward F. Katzenburger*, United Aircraft Corp.

9:30 a.m.

Gas Turbine Power (III)

The Evolution of a Small Turbojet[1]

Measurements of Relative-Flow Distributions in Mixed-Flow Impellers[1]

9:30 a.m.

Oil and Gas Power (II)

The Development of a Supercharged Medium-Speed Two-Cycle Opposed Piston Engine, by *A. K. Antonsen*, Fairbanks, Morse & Co. (Paper No. 56—A-99)

Design and Development of a Two-Cycle Turbocharged Diesel Engine, by *P. J. Louzecky*, General Motors Corp. (Paper No. 56—A-100)

9:30 a.m.

Heat Transfer (V)

Convection Heat-Transfer and Pressure Drop of Air Flowing Across In-Line-Tube Banks. Part 1—**Apparatus, Procedures, and Special Effects,** by *C. E. Jones*, The Babcock & Wilcox Co., and *E. S. Monroe, Jr.*, E. I. du Pont de Nemours & Co., Inc. (Paper No. 56—A-126)

Part 2—**Correlation of Data for Ten-Row-Deep Tube Banks,** by *A. J. Gram, Jr.*, The Babcock & Wilcox Co.; *C. O. Mackey*, Cornell University; and *E. S. Monroe, Jr.*, E. I. du Pont de Nemours & Co., Inc. (Paper No. 56—A-127)

Shell-Side Characteristics of Shell and Tube Heat Exchangers—A Rating System for Commercial Heat Exchangers, by *Townsend Tinker*, American Radiator & Standard Sanitary Corp. (Paper No. 56—A-123)

Heat-Transfer and Fluid Friction During Flow Across Banks of Tubes, by *O. P. Bergelin*, University of Delaware; *K. J. Bell*, Case Institute of Technology; and *M. D. Leighton*, University of Delaware (Paper No. 56—A-133)

9:30 a.m.

Hydraulic (V)

Cavitation

Accelerated Field Tests of Cavitation Intensity, by *R. T. Knapp*, California Institute of Technology (Paper No. 56—A-57)

Progress Report on Standardization of the Vibratory Cavitation Test, by *L. E. Robinson, Jr.*, Allis-Chalmers Manufacturing Co.; *B. A. Holmes*, The Hydro-Electric Power Commission of Ontario, Toronto, Ont., Canada; and *W. C. Leith*, Dominion Engineering Works, Ltd., Montreal, Que., Canada (Paper No. 56—A-85)

9:30 a.m.

Furnace Performance Factors (I)—Corrosion and Deposits From Combustion Gases (II)

Calculation of Theoretical Flame Temperatures in Furnaces[1]

In-Service Washing of Ljungstrom Air Preheaters on Pulverized-Coal-Fired Steam Generator, by *H. J. Hupfer, A. H. Van Sickle* and *R. J. Stanley*, Detroit Edison Co. (Paper No. 56—A-161)

The Formation of Sulphuric Acid in Boiler-Flue Gases, by *W. F. Harlow*, International Combustion Products Ltd., Derby, England (Paper No. 56—A-159)

9:30 a.m.

Production Engineering (IV)

Economic Lot-Size Considerations in Production Scheduling[1]

The CP Machine-Tool Index—A Method of Analyzing Process-Capability Studies[1]

9:30 a.m.

Metal Processing (IV)

The Influence of Various Grinding Conditions Upon Residual Stresses in Titanium, by *P. A. Clorite* and *E. C. Reed*, Pratt & Whitney Aircraft Co. (Paper No. 56—A-44)

A Tool-Work-Thermocouple Compensating Circuit, by *K. J. Trigger, R. K. Campbell*, and *B. T. Chao*, University of Illinois (Paper No. 56—A-90)

On the Theoretical Analysis of a Dynamic Thermocouple, by *E. W. Gaylord, W. F. Hughes, F. C. Appl,* and *F. F. Ling,* Carnegie Institute of Technology (Paper No. 56—A-86)

9:30 a.m.

American Rocket Society (III-A)

High-Altitude Sounding Rockets—Part 1

9:30 a.m.

American Rocket Society (III-B)

Liquid-Propellant Rockets

12:15 p.m.

Members and Students Luncheon

Presider: *Joseph W. Barker,* ASME President

Remarks by: Retiring President and Incoming President

Address by: *J. William Jacobson,* Old Guard Prize Winner in the Student Papers Competition

2:00 p.m.

International Conference on Fatigue of Metals (II)

Stress Distribution

2:30 p.m.

Applied Mechanics (VII)

Stresses and Displacements in an Elastic-Plastic Wedge, by *P. M. Naghdi,* University of Michigan (Paper No. 56—A-20)

A New Method for the Construction of Hencky-Prandtl Nets, by *E. G. Thomsen,* University of California (Paper No. 56—A-14)

Yield Loads of Slabs With Reinforced Cutouts, by *P. G. Hodge, Jr.* and *Nicholas Perrone,* Polytechnic Institute of Brooklyn (Paper No. 56—A-7)

A Theoretical Criterion for the Fracture of Metals Under Combined Alternating Stresses[2], by *Takeo Yokobori,* Tohoku University, Sendai, Japan (Paper No. 56—A-21)

A Statistical Appraisal of the Prot Method for Determination of Fatigue Endurance Limit,[2] by *Wasfi A. Hijab,* American University of Beirut, Beirut, Lebanon (Paper No. 56—A-50)

2:30 p.m.

Power (VIII)—Metals Engineering (IV)

Operating Experience With Alloy Steels at High Temperatures and Pressures

Eight Years of Experience With Austenitic-Steel Piping Materials at Elevated Steam Conditions, by *F. P. Fairchild,* Public Service Electric & Gas Co. (Paper No. 56—A-181)

Metallurgical Considerations of Main Steam Piping for High-Temperature High-Pressure Service, by *H. S. Blumberg,* The M. W. Kellogg Co. (Paper No. 56—A-157)

2:30 p.m.

Aviation (VI)

The Effect of Heavy Rainstorms on J47 Turbojet Operation, by *S. S. Wayne,* General Electric Co. (Paper No. 56—A-151)

Experience With Water-Alcohol Injection on J47 Engine, by *M. K. Wolfson,* General Electric Co. (Paper No. 56—A-152)

A Dynamic Performance Computer for Gas-Turbine Engine[1]

2:30 p.m.

Railroad (I)—Nuclear Engineering (III)

Progress in Railway Mechanical Engineering 1955–1956[1]

A Progress Report on the Development of an Atomic-Powered Locomotive, by *B. C. Gunnell,* Bush Hill Development Corp. (Paper No. 56—A-79)

The Use of Atomic Energy in the Testing of Materials, by *W. M. Keller,* Central Research Laboratory (Paper No. 56—A-81)

2:30 p.m.

Gas Turbine Power (IV)

Recovery Ratio—A Measure of the Loss-Recovery Potential of Compressor Stages[1]

Aerodynamic Design of Vaned Diffusers for Centrifugal Compressors[1]

[1] Paper not available—see box on page 972.
[2] Not presented orally.

2:30 p.m.

Oil and Gas Power (III)

Future Development of the High-Speed Diesel Engine, by *Ernest Chatterton,* D. Napier & Son, Ltd., London, England (Paper No. 56—A-141)

Torque Converters—A Versatile Drive, by *H. L. Wilke,* The National Supply Co. (Paper No. 56—A-138)

2:30 p.m.

Heat Transfer (VI)

Heat Transfer From a Rotating Cylinder, With and Without Cross Flow, by *W. M. Kays* and *I. S. Bjorklund,* Stanford University (Paper No. 56—A-71)

Heat-Transfer Characteristics of Rotational and Axial Flow Between Concentric Cylinders, by *Carl Gazely, Jr.,* Rand Corp. (Paper No. 56—A-128)

Heat Transfer From a Rotating Disk in Turbulent Flow,[3] *Frank Kreith* and *J. H. Taylor, Jr.,* Lehigh University (Paper No. 56—A-146)

Sublimation From Disks to Air Flowing Normal to Their Surfaces, by *H. H. Sogin,* Brown University (Paper No. 56—A-115)

2:30 p.m.

Hydraulic (VI)

Water Hammer

Report of Committee on Water Hammer ASME, 1951 to 1956[1]

Computer Representations of Engineering Systems Involving Fluid Transients, by *H. M. Paynter,* Massachusetts Institute of Technology and Pi-Square Engineering Co., Inc., and *F. D. Ezekial,* Massachusetts Institute of Technology (Paper No. 56—A-120)

Case Histories From 35 Years' Experience With Water Hammer[1]

2:30 p.m.

Metal Processing (V)

Temperature Distribution at Tool-Chip and Tool-Work Interface in Metal Cutting, by *B. T. Chao* and *K. J. Trigger,* University of Illinois (Paper No. 56—A-87)

Transient Interface Temperatures in Plain Peripheral Milling, by *D. E. McFeron* and *B. T. Chao,* University of Illinois (Paper No. 56—A-89)

2:30 p.m.

American Rocket Society (IV-A)

High-Altitude Sounding Rockets—Part 2

2:30 p.m.

American Rocket Society (IV-B)

Atomization and Sprays

6:00 p.m.

Social Hour

7:00 p.m.

Banquet

(Formal Attire)

THURSDAY, NOVEMBER 29

8:00 a.m.

Registration

9:00 a.m.

International Conference on Fatigue of Metals (III)

Stress Distribution, Statistical Aspects and Effect of Frequency

9:30 a.m.

Applied Mechanics (VIII)

Point Source and Point Vortex in the Hodograph Plane, by *H. Poritsky* and *R. A. Powell,* General Electric Co. (Paper No. 56—A-78)

Head Loss in Flow Through a Cyclone-Dust Separator or Vortex Chamber, by *H. E. Weber,* Shell Development Co., and *J. H. Keenan,* Massachusetts Institute of Technology (Paper No. 56—A-8)

Effect of Adverse Pressure Gradients on Turbulent Boundary Layers in Axisymmetric Conduits, by *J. M. Robertson,* University of Illinois, and *J. W. Holl,* U. S. Army (Paper No. 56—A-25)

[3] Ten-minute presentation.

9:30 a.m.

Power (IX)

Marine Session

High-Frequency Vibration of Steam-Turbine Buckets, by *F. L. Weaver* and *M. A. Prohl,* General Electric Co. (Paper No. 56—A-119)

A Method for Calculating Vibration Frequency and Stress of a Banded Group of Turbine Buckets, *M. A. Prohl,* General Electric Co. (Paper No. 56—A-116)

Boiler Vibration Caused by Combustion Gas Flow[1]

Experimental Determination of Gear-Tooth Stresses in Large Marine Gears, by *H. W. Semar* and *R. E. McGinnis,* Westinghouse Electric Corp. (Paper No. 56—A-117)

9:30 a.m.

Railroad (II)—Oil and Gas Power (IV)

The Hydromechanical-Drive Diesel for High-Speed Ultra-Lightweight Passenger Trains[1]

Two Dual-Powered High-Speed Locomotives for a New Haven Railroad Lightweight-Passenger Train, by *R. Aldag,* Fairbanks, Morse & Co., and *F. L. Sahlmann,* General Electric Co. (Paper No. 56—A-68)

Airbrakes for High-Speed Ultra-Lightweight Passenger Trains, by *T. H. Bickerstaff,* Atchison, Topeka & Santa Fe Railway System (Paper No. 56—A-66)

9:30 a.m.

Gas Turbine Power (V)—Hydraulic (VII)

Current Applications of Gas Turbines[1]

Pressure Drop and Air-Flow Distribution in Gas-Turbine Combustors[1]

9:30 a.m.

Heat Transfer (VII)—Fuels (IV)—Furnace Performance Factors (II)—Heat-Conduction Charts

Estimation of Temperature Patterns in Multiple-Shielded Systems, by *J. G. Bartas,* General Electric Co., and *E. Mayer,* Arde Associates (Paper No. 56—A-130)

Heat Transfer by Radiation From Flames, by *R. A. Sherman,* Battelle Memorial Institute (Paper No. 56—A-111)

Effects of Junction Manufacture on Thermocouple E.M.F. Generation, by *E. A. Farber,* University of Florida, and *M. R. Glickstein,* University of Illinois (Paper No. 56—A-135)

Compilation of Radiation-Shape Factors for Cylindrical Assemblies,[2] by *H. Leuenberger* and *R. A. Person,* Electro Metallurgical Co. (Paper No. 56—A-144)

Rate of Temperature Change of Simple Shapes, by *Victor Paschkis* and *J. W. Hlinka,* Columbia University (Paper No. 56—A-118)

9:30 a.m.

Machine Design (VI)

Design Mechanics

Vibration-Design Charts, by *J. N. Macduff,* Duke University, and *R. P. Felgar,* General Electric Co. (Paper No. 56—A-75)

Characteristics of Unevenly Underlapped Four-Way Hydraulic Servo Valves, by *Tsun-Ying Feng,* Minneapolis-Honeywell Regulator Co. (Paper No. 56—A-140)

Impact Stresses in Drop-Hammer Guides, by *Franz Koenigsberger,* Manchester University, Manchester, England, and *S. R. Ghabrial,* Ein Shams University, Abbassia, Cairo, Egypt. To be presented by *A. S. Hall, Jr.,* Purdue University (Paper No. 56—A-12)

9:30 a.m.

Wood Industries (I)

Wood in Building Construction

The Design of a Timber-Roof Truss With Nail-Glued Connections, by *B. M. Radcliffe,* Place Enterprises, Inc. (Paper No. 56—A-180)

Recent Developments in Engineered Timber Construction, by *J. C. Van Dyke,* Unit Structures, Inc.(Paper No. 56—A-136)

Fire Safety of Engineered Timber Construction, by *F. J. Hanrahan,* American Institute of Timber Construction (Paper No. 56—A-137)

9:30 a.m.

Production Engineering (V)

Economic Considerations in the Development and Use of Mechanical Assembly Equipment, by *G. R. Fitzgerald,* General Motors Corp. (Paper No. 56—A-83)

Fabrication of Vulcanized Fiber, by *J. Macadam,* National Vulcanized Fibre Co. (Paper No. 56—A-95)

9:30 a.m.

Rubber and Plastics (I)

The Fundamental Mechanics of Reinforced Plastics[1]

Penton—A New Chlorine-Containing Polyether[1]

Electrical Effects Accompanying the Stick-Slip Phenomenon of Sliding of Metals on Plastics and Lubricated Surfaces, by *S. M. Skinner* and *Joseph Gaynor,* General Electric Co., and *G. W. Sohl,* Case Institute of Technology (Paper No. 56—A-163)

A Review of Developments in Plastics Engineering 1955-1956[1]

9:30 a.m.

American Rocket Society (V-A)

Project Vanguard Propulsion Symposium (Classified)

9:30 a.m.

American Rocket Society (V-B)

Instrumentation and Guidance

12:15 p.m.

International Conference on Fatigue of Metals Luncheon

12:15 p.m.

Wood Industries Luncheon

Address by: *Harry H. Steidle,* Prefabricated Home Manufacturers Institute

12:30 p.m.

Railroad Division Luncheon

Presider: *T. F. Perkinson,* General Electric Co.

Speaker: *William White,* Delaware & Hudson Railroad Corp.

Subject: **The Current Railroad Scene**

2:00 p.m.

International Conference on Fatigue of Metals (IV)

Metallurgical Aspects, Effects of Temperature, Corrosion

2:30 p.m.

Applied Mechanics (IX-A)

A New Approach to the Theory of Thin, Slightly Cambered Profiles, by *F. S. Weinig,* General Electric Co. (Paper No. 56—A-33)

The Two-Dimensional Inflow Conditions for a Supersonic Compressor With Curved Blades, by *Philip Levine,* Wright Air Development Center (Paper No. 56—A-49)

A Theoretical Analysis of the Viscous Flow in a Narrowly Spaced Radial Diffuser, by *H. W. Woolard,* Cornell Aeronautical Laboratory (Paper No. 56—A-18)

Two-Dimensional, Steady, Cavity Flow About Slender Bodies in Channels of Finite Breadth, by *Hirsh Cohen,* Rensselaer Polytechnic Institute, and *Robert Gilbert,* Carnegie Institute of Technology (Paper No. 56—A-29)

2:30 p.m.

Power (X)—Safety (I)

Service Experience With Austenitic Welded Joints at the High Steam Temperatures[1]

Are Standards or Codes Practical for Ultrasonic Examination of Metals and Welding?[1]

An Investigation of Thermal Stress Fatigue as Related to High-Temperature Piping Flexibility, by *L. F. Coffin, Jr.,* General Electric Co. (Paper No. 56—A-178)

2:30 p.m.

Railroad (III)

The Combination Vehicle as a Special Freight Car for Industry[1]

The Effect of Improved Draft Gears and Spring-Dampened Trucks on Freight-Car Shocks, by *H. W. Faus,* New York Central System (retired) (Paper No. 56—A-80)

Trailers in Piggy-Back Operation From a Manufacturer's Point of View, by *J. J. Black,* Trailmobile Inc. (Paper No. 56—A-82)

2:30 p.m.

Gas Turbine Power (VI)

French Experience With Free-Piston Gasifiers[1]

A New Concept in Engine Gas-Generator Turbine Plant[1]

Bibliography on Free-Piston Engines and Compressors,[2] by *B. H. Jennings,* Northwestern University, and *J. A. Scanlan,* University of Texas (Paper No. 56—A-23)

2:30 p.m.

Power Test Codes

Instrumenting a Field Study of Water Cooling Tower Performance, by *J. L. Willa,* Cooling Tower Institute (Paper No. 56—A-22)

Cooling Towers for Steam-Electric Stations—Selection and Performance Experiences, by *M. W. Larinoff,* Ebasco Services, Inc. (Paper No. 56—A-59)

2:30 p.m.

Machine Design (VII)—Applied Mechanics (IX-B)

Designing Jet Engines With a Medium-Size Digital Computer, by *F. R. Heath,* Westinghouse Electric Corp. (Paper No. 56—A-143)

Two Applications of a Digital Computer to Machine-Design Problems, by *J. T. Lester, Jr.,* E. I. du Pont de Nemours & Co., Inc. (Paper No. 56—A-98)

The Use of Digital Computers in the Mechanical Design of Large Steam Turbines, by *E. E. Zwicky, Jr.,* General Electric Co. (Paper No. 56—A-139)

2:30 p.m.

Wood Industries (II)

Panel Discussion: Wood Prefabricated Housing

Willard J. Worth, National Homes Corp.
John K. White, American Houses, Inc.
C. S. Van Aukens, Weyerhauser Corp.
W. G. Best, Best Factory-Built Homes
James T. Lendrum, University of Illinois

2:30 p.m.

Production Engineering (VI)

A New Look at Shell Castings, by *H. G. Sieggreen,* General Motors Corp. (Paper No. 56—A-94)

2:30 p.m.

Rubber and Plastics (II)

Polymer Properties Involved in Process-Equipment Design, by *H. J. Karam,* Dow Chemical Co. (Paper No. 56—A-175)

Roll Bending Applied to Rubber and Plastic Calenders, by *R. C. Seanor,* Adamson United Co. (Paper No. 56—A-176)

High Horsepower Banbury Mixing[1]

Recent Development in Extrusion of Elastomers[1]

2:30 p.m.

American Rocket Society (VI)

Project Vanguard Guidance Symposium (Classified)

6:30 p.m.

Power Test Codes Dinner

7:00 p.m.

American Rocket Society Honors Night Dinner

Address by: *James S. Russell,* Rear Admiral, USN, Chief of Bureau of Aeronautics

8:00 p.m.

Applied Mechanics (X)—Heat Transfer (VIII)

The State Principle, by *S. J. Kline* and *F. O. Koenig,* Stanford University (Paper No. 56—A-4)

A New Method to Measure Prandtl Number and Thermal Conductivity of Fluids, by *E. R. G. Eckert* and *T. F. Irvine, Jr.,* University of Minnesota (Paper No. 56—A-32)

Corrections for the Oscillating-Disk Viscometer, by *Joseph Kestin* and *Hung En Wang,* Brown University (Paper No. 56—A-34)

Velocity, Temperature, and Heat-Transfer Measurements in a Turbulent Boundary Layer Downstream of a Stepwise Discontinuity in Wall Temperature, by *D. S. Johnson,* Bell Telephone Laboratories, Inc. (Paper No. 56—A-19)

8:00 p.m.

Materials Handling (VI)—Production Engineering (VII)—Management (III)

Symposium: Materials-Handling Methods

Materials-Handling Aspects Applied to Industrial-Plant Construction[1]

Movement Packaging[1]

Bulk-Solids Feeder Design[1]

FRIDAY, NOVEMBER 30

8:00 a.m.

Registration

9:00 a.m.

International Conference on Fatigue of Metals (V)

Engineering and Industrial Significance of Fatigue—General Service, Automobile, Railways, Marine Engines, Aircraft Engines, Welding

9:30 a.m.

Textile Engineering (I)

Wool Finishing—Part 1

Continuous Dyeing of Tufted Carpets[1]

Results of Plant Installations of Compacting Machines[1]

New Drying-Machine Developments[1]

9:30 a.m.

Boiler Feedwater Studies (I)

What Do Modern High-Pressure Boilers Demand of Feedwater[1]

The Performance of the Demineralizer in the Preparation of High-Quality Water[1]

Evaporated Makeup Water for a Monotube Boiler[1]

9:30 a.m.

Process Industries (I)

Spray-Dryer Design Calculations[1]

Analysis of a Process-Fluid-Flow Network by Electrical Analogy[1]

9:30 a.m.

Safety (II)

Safety Standards—Everybody's Business[1]

The Human Factor in Machine Design, by *T. F. Hatch,* University of Pittsburgh (Paper No. 56—A-46)

Toxicity of Materials of Interest to the Mechanical Engineer, by *J. B. Skinner,* American Mutual Liability Insurance Co. (Paper No. 56—A-56)

9:30 a.m.

American Rocket Society (VII)

Space-Flight Symposium

12:15 p.m.

Textile Engineering Luncheon

2:00 p.m.

International Conference on Fatigue of Metals (VI)

Engineering and Industrial Significance of Fatigue—Aircraft Structures

2:30 p.m.

Textile Engineering (II)

Wool Finishing—Part 2

Drives for Wool and Worsted Finishing Machines[1]

Technique of Practical Plant-Layout Planning for Finisher Plants[1]

Heat-Balance Studies in Finisher Plants[1]

2:30 p.m.

Boiler Feedwater Studies (II)

The Use of Bureau of Mines' Condensate-Corrosion Testers for Survey of Return-Line Deterioration, by *A. A. Berk,* Bureau of Mines (Paper No. 56—A-179)

Steam-Purity Studies Comparing Sodium and Conductivity Methods[1]

Selecting Water-Treating Processes for Medium Pressure[1]

2:30 p.m.

Process Industries (II)

Gas-Motor Air Conditioner[1]
Heat Pump[1]

[1] Paper not available—see box on page 972.

[2] Not presented orally.

WOMEN'S PROGRAM

Sunday, November 25

4:00 p.m. "Early Bird" Party—National Arts Club

Monday, November 26

9:00 a.m. Registration Coffee Hour—Hote Statler
12:15 p.m. President's Luncheon—Ballroom, Hotel Statler
4:00 p.m. Tea Dance—Georgian Room, Hotel Statler
7:00 p.m. Cellar in the Clouds

Tuesday, November 27

8:30 a.m. President's Breakfast for National Board—Hotel Statler
9:00 a.m. Coffee Hour—Hotel Statler
10:30 a.m. Tour of New York City
12:30 p.m. Annual Luncheon and Fashion Show—Waldorf Astoria Hotel
7:00 p.m. Buffet Supper and Carnival Night—Hotel Statler

Wednesday, November 28

10:00 a.m. Auxiliary Annual Meeting—Hotel Statler
12:30 p.m. Past-Presidents' Luncheon—Fifth Avenue Hotel
6:00 p.m. Social Hour—Georgian Room, Hotel Statler
7:00 p.m. Banquet—Ballroom, Hotel Statler

Thursday, November 29

10:30 a.m. Audrey Jocelyn Flower Program—Hotel Statler
12:30 p.m. Luncheon and Speaker—Hampshire House

ASME Woman's Auxiliary Educational Funds Report

THE 1956–1957 Calvin W. Rice Scholarship Fund of $1500 to a foreign student for graduate work in the United States has been awarded to Nicholas W. Koumoutsos of Athens, Greece, and he is entered as a graduate student at the Illinois Institute of Technology, Chicago, Ill. The Institute has given him a tuition scholarship and he will take advanced work in mechanical vibration and study American methods of engineering teaching. He will receive a Fulbright Travel Grant to and from the United States. He expects to return to his teaching at the University of Greece after a year of study here.

The Sylvia W. Farny Scholarship Fund of $500, awarded each year to man or woman undergraduate student in mechanical engineering for use in final year of study, has been increased this year to three awards. Originally, because of the many engineering schools throughout the country, they were divided into groups. The award of scholarships was rotated annually among these groups. This year all colleges will be considered collectively. If this proves satisfactory, it will become the annual policy. The recipients for 1956–1957 are: Harvey E. Maseck, Ohio State University; Karl J. Springer, A&M College of Texas; and Paul S. Bodeau, Marquette University.

The Student Loan Fund continues to be active, with loans to students in 13 colleges, representing an original grant of $9440. Application blanks and information sheets are on file at all accredited engineering schools.

Junior Forum

Conducted for the National Junior Committee

by R. A. Cederberg,[1] Assoc. Mem. ASME

Growth Pattern of the Engineer[2]

By Robert Nelsen[3]

PROFESSIONAL development is really an individual and personal thing which we should occasionally look at to see how we are doing. Soon after graduation, the conscientious engineer will be wondering, "How am I doing?" but he can find no fixed answer. Even the relatively objective measurement of his technical competence, which examinations have provided, will be impossible. Technical competence is only one of many criteria which must be considered in answering the question, "How am I doing?" It will be professional development not technical proficiency alone that he will need to measure.

First of all, he will have to consider that upon graduation he gained an old and illustrious title. He has, in effect, earned a professional pedigree. He will also find, as time goes by, that his associates will attempt to judge his title by him. Does he himself deserve the kind of respect he thinks his profession should command?

Secondly, he will have to consider that, in becoming an engineer, he has accepted an important scientific heritage, and a great social responsibility. The engineer's social function is to utilize scientific knowledge and scientific methods to create serviceable technological devices—devices whose end is social utility. He is not primarily concerned with knowledge for knowledge's sake, but rather, his primary function is to utilize such knowledge to make this a better world in which to live. In measuring his professional development a man will have to ask himself whether or not he has, in his daily work, contributed his share toward reducing the gap between theory and production. Has he used the best knowledge available in solving his problem?

In measuring his professional development the engineer will have to ask himself whether or not he has accepted his full share of social responsibility in preventing the abuse of his creations. Has he utilized the added leisure provided by modern technology to become a wiser man and has he made his voice heard in local and national organizations? In effect, has he accepted the responsibility that his professional status thrusts upon him? Has he kept his professional development in accord with the requirements of modern society?

What is professional development? Professional development of the engineer is a summation of his technical development, personal growth, and community-affairs participation.

Technical Development

One phase of growth is technical development. Very frequently an engineer's technical ability is gaged by length of technical service or experience. This is satisfactory provided adequate consideration has been given to the tenets of good technical experience. There are essentially four criteria which should be used to judge an engineer's technical development:

1 *Technical Accomplishment.* The engineer's technical accomplishment is measured by his ability to get at the heart of a problem and arrive at a satisfactory conclusion as expeditiously as possible, and be right most of the time.

Technical problems do not always involve mathematical solutions but do require good, sound technical judgment. Good judgment is partly inherent but more often the result of good or well-guided experience. A young engineer looks toward his company and particularly the older employees with whom he is associated for guidance in order that his experience might be of the nature which will help him to develop in the type of engineering work that he desires. Older company employees should go out of their way to help the younger engineers work out their experience problems. With such help, the young engineer will develop good technical judgment.

2 *Technical Societies.* This broad knowledge of the activity in engineering is requisite for professional status. A profession requires more than training, specialization, and experience—it also requires understanding. The engineer's participation in the activities of technical societies is his best way of achieving the understanding that makes for technical development. Participation in technical societies is primarily the responsibility of the individual. If he will but take the initiative he will find that a forward-looking company will encourage his participation in technical societies' meetings and committee work. The individual should volunteer the writing of technical papers for presentation at society meetings. This is a most effective way of becoming known and recognized in the engineering profession.

[1] Westinghouse Electric Corp., Radio-TV Division, Metuchen, N. J.

[2] Presented at Engineers Joint Council, Second General Assembly, January, 1956, New York, N. Y.

[3] General Electric Company, Gas Turbine Division, Cincinnati, Ohio. Mem. ASME.

3 *Ethics*. Another element enters into this question of professional development: Ethics. If we think of those vocations which we would classify immediately as "professions," we would attach to them an idea of ethics, a discipline which the individual enforces upon himself. Ethical behavior is simply a regard for the rights of others. Respect is not legislated. We cannot buy it, nor can we get it by passing motions, nor by publicity. It must be developed.

4 *Registration*. Registration is a part of the engineer's responsibility to the community. The engineer is the possessor of specific skills which are designed to contribute to the public welfare, to protect the public from poorly qualified practitioners. Even though registration is not mandatory in every community or state, the individual engineer should recognize the purpose of registration and co-operate fully. Registration is clearly a step in professional development, a duty owed the community.

Personal Growth

A second phase of professional development is personal growth. In order for an engineer to grow professionally, he must grow in personality and character. He can sell his ideas only after he has sold himself.

College training for a technical career, unfortunately, does not leave much time for those subjects which make for better human relations. The planned use of leisure time can compensate for those areas which were omitted from our engineering training. Two areas stand out as needing special consideration:

1 *Communication*. First, let us consider the art of communication. We all remember those long nights in college when we sweated over reports to be written for the next day; and when we dreaded the public-speaking courses we had to take. What, we wanted to know, does writing and speaking have to do with engineering? It was not until we actually became involved in engineering that we realized that ideas are no good unless they are communicated; that a machine cannot be operated unless there are instructions; that new ideas must be explained and sold. Too few of us have the fluent command of our own language which is necessary to clear communication.

2 *Personality and Self-Confidence*. One of the most important factors in the status of any profession is respect; and respect is gained only through personal contacts with other people. Each one of us is a representative of the engineering profession to those who are not engineers; and our personal public relations demand that we learn to communicate, that we try to achieve pleasant personalities, and that we acquire self-confidence. It is worthwhile to note that these attributes not only enhance the reputation of the individual and the dignity of the engineering profession but also contribute to the status of the industry which employs the engineer.

Participation in Community Affairs

Now we come to the third phase in professional development, participation in community affairs.

The first two phases, technical accomplishment and personal growth, are characteristics relating to the individual and his job. Neither of these has adequate meaning if it is removed from the frame of reference of the society in which they exist.

We have been discussing the growth pattern of the engineer. The term "profession" carries with it a connotation of service—a service separated from notions of personal gain. Just as technical accomplishment serves as a measure of the engineer's value to modern technology, and personal development serves as an index of his value to himself, participation in community affairs is a criterion of his value to society. The respect of others, which is so basic to a profession, depends largely upon this contribution to community affairs.

Quite apart from the idea of a profession and our desire to impress upon our people the idea that engineering *is* a profession, there are two reasons why the engineer must participate in community affairs; his qualifications and his responsibility.

All of the engineer's training is a training in problem solving. It is a training in the observation of facts, the measurement of facts, and the evaluation of facts. Throughout his undergraduate training, the engineer is schooled in the rigid logic of mathematics and in the application of that logic to problems in the physical sciences. Throughout his productive career, the engineer utilizes that training in solving new problems and in developing new ideas into useful devices for the society in which he lives.

Once having carried his development of an idea to the point where it becomes a device useful to society, he has abandoned it for another idea. Until recently, the engineer has been generally content to let it go at that.

But society has become complex as any problem in the physical sciences, and the engineer must learn to apply the methods which solve engineering problems to the problems which afflict society. He cannot abandon his idea once it has been developed into a useful device. He must assume the responsibility for seeing that it is not misused.

It is not enough that we conserve energy through work-saving devices. We must see to it also that the time saved is used for constructive purposes, that leisure does not mean idleness, that the cutting of production time does not mean unemployment. If our work is supposed to serve humanity, we must assure ourselves that it accomplishes its purpose.

This work is accomplished largely on the community level—church groups, school boards, local governments, and such service groups as Kiwanis, Rotary, and Chamber of Commerce. Participation in such organizations will help to dispel the habit of regarding the engineer as more of a specialist than a man.

Participation in community affairs, then, is the third phase in professional growth. If the young engineer continues to improve his specialized techniques and broaden his technical comprehension, to grow in personality and character, to assume responsibility in the affairs of his community, he is developing professionally.

These three phases of professional development—community affairs participation, personal growth, and technical development—serve to evaluate the progress of the engineer as a contributing specialist to technology, as a growing personality, and as a conscientious citizen. Any and all of the several categories within these three general classifications will serve as a means for determining how well the young engineer is developing. If growth in all these classifications is evident, then he can say in all humility, "I am an engineer."

What ASME Engineers Have to Say on Manpower Shortage

In response to a questionnaire distributed at the 1956 ASME Semi-Annual Meeting in Cleveland, Ohio, 220 ASME members have commented on the current shortage of engineers.

An analysis of their responses, together with some significant tabulations, is included in this article.

The 220 individuals responding came from 33 states and the District of Columbia as well as six foreign countries. Heaviest representation was from Ohio (31), Pennsylvania (28), New York (27), New Jersey (14), and California (12).

For exact wording of the questions refer to the copy of the questionnaire on page 981.

High School Contribution

Most respondents thought their high schools had done a good or superior job of preparing them for the study of engineering. Ratings were as follows: Superior, 28 per cent; good, 54 per cent; mediocre, 11 per cent; poor, 3 per cent.

Engineers graduated from high school before 1936 had a significantly better opinion of their schools than later graduates. See Table 1 on page 980.

In the former group 34 per cent rated their high schools as superior, as against 21 per cent for the latter group, and only 11 per cent of the older group rated their high schools as mediocre, compared with 22 per cent of the younger group.

College Ratings

The respondents were even more positive in defending the records of their engineering schools. See Table 2 on page 980, for breakdown. Score for the over-all group ran: Superior, 41 per cent; good, 55 per cent; mediocre, 4 per cent; poor, none.

Pre-1946 graduates scored their colleges higher than did the postwar crop—46 per cent superior as against 33 per cent.

Table 1

Based on replies to the question: "What kind of a job do you think your high school did in preparing you for an engineering education?"

High School Graduation Year	Superior	Good	Medi-ocre	Poor
Before 1900			1	
1901–1905		1		
1906–1910	1			
1911–1915	3	6	2	
1916–1920	9	8	3	1
1921–1925	10	9	2	
1926–1930	4	17		1
1931–1935	11	20	2	1
1936–1940	14	27	14	2
1941–1945	8	25	10	1
1946–1950	1	6		*
Total Percentages	61 (28%)	119 (54%)	34 (11%)	6 (3%)
Before 1936	38 (34%)	61 (54%)	10 (9%)	3 (3%)
1936 and after	23 (21%)	58 (54%)	24 (22%)	3 (3%)

Table 2

Based on replies to the question: "What kind of a job do you think your college did in preparing you for the profession of engineering?"

College Graduation Year	Superior	Good	Medi-ocre	Poor
1901–1905		1		
1906–1910	1			
1911–1915	1	1		
1916–1920	5	7		
1921–1925	7	7	1	
1926–1930	12	7		
1931–1935	11	17		
1936–1940	15	17	2	
1941–1945	12	14	1	
1946–1950	19	38	3	
1951–1956	9	14	1	
Totals*	92	123	8	0
Percentages	(41%)	(55%)	(4%)	(0%)
Before 1946	64	71	4	0
Percentages	(46%)	(51%)	(3%)	(0%)
1946 and after	28	52	4	0
Percentages	(33%)	(62%)	(5%)	(0%)

*223 ratings out of 220 questionnaires; some listed more than one school.

Table 3

Based on most frequent replies to the question: "In your opinion, what could the high schools of America do to prepare students better for engineering study?"

Reply	Total Giving This Reply	Percentage of Total (220) Questionnaires
Improve technical course content (addition and improvement of courses in mathematics, physics, chemistry, etc.)	111	50%
Improve teaching methods	54	25%
Improve nontechnical course content (addition and improvement of courses in English, languages, classics, etc.)	24	11%
Improve vocational-guidance information	18	8%
Get better teachers and better facilities	16	7%
Enlist support of industry	10	5%
More pay for teachers	8	4%
Special attention for superior students	8	4%
	249*	*

* Some respondents gave more than one reply.

Table 4

Based on most frequent replies to the question: "In your opinion, what could the engineering schools of America do to prepare students better for the profession of engineering?"

Reply	Total Giving This Reply	Percentage of Total (220) Questionnaires
Teach the fundamentals and reduce emphasis on specialization	46	21%
Broaden the engineering curriculum to include more liberal arts and/or business courses	22	10%
Increase the emphasis on science and mathematics and reduce emphasis on liberal arts course	19	9%
Extend the four-year course to five years or more	14	6%
Get better teachers by increasing teacher pay	11	5%
Keep schools abreast of current developments	7	3%
Total	109*	*

* Some respondents gave more than one reply; some did not reply to this question; some gave replies that occurred too infrequently to record here.

Table 5

Based on replies to the question: "What measures do you think should be taken to end the shortage of engineering manpower?"

Reply	Total Giving This Reply	Percentage of Total (220) Questionnaires
Make better use of the engineers we have, and lighten their burdens by using technicians to carry out routine details	74	34%
Pay more money, especially to men who have been in the profession for some time	58	26%
Do a better job of selling the profession to young people	48	22%
Increase the prestige and recognition of the profession through publicity and other means	20	9%
No real shortage exists	13	6%
Stop hoarding of engineers by companies	7	3%
Leave it to the law of supply and demand, or to the free enterprise system	7	3%
	227*	*

* Some respondents gave more than one reply.

Improving High Schools

About half of the group thought that high schools ought to add, improve, or make compulsory, courses in mathematics, physics, and chemistry, and otherwise better the *content* of technical courses. One fourth thought that improvement of teaching *methods* would help improve preparation for engineering study. Eleven per cent called for addition or improvement of courses in English, languages, the classics, and other nontechnical subjects.

Only four per cent suggested more pay for teachers as a solution. See Table 3 on this page.

Better College Study

The widest spread of replies came to the question: "In your opinion, what could the engineering schools of America do to prepare students better for the profession of engineering?" The largest group of replies, 21 per cent, urged the schools to teach fundamentals and reduce the emphasis on specialization.

On the question of whether the curriculum ought to include more or fewer liberal arts and business courses, 10 per cent voted for an increase, while 9 per cent said they thought liberal arts courses ought to be cut in favor of more emphasis on science and mathematics.

ASME SEMI-ANNUAL MEETING QUESTIONNAIRE

(Please fill out and return to registration desk. *You need not sign.*)

1 What kind of a job do you think your high school did in preparing you for an engineering education? Superior ____ Good ____ Mediocre ____ Poor ____ (Check one.)

In your opinion, what could the high schools of America do to prepare students better for engineering study? ____

City where you went to high school ____

Year of graduation ____

2 What kind of a job do you think your college did in preparing you for the profession of engineering? Superior ____ Good ____ Mediocre ____ Poor ____ (Check one.)

In your opinion, what could the engineering schools of America do to prepare students better for the profession of engineering? ____

Name of college attended ____

Year of graduation ____

3 What measures do you think should be taken to end the shortage of engineering manpower? ____

(USE REVERSE FOR FURTHER COMMENT)

Questionnaire on Manpower Shortage

Six per cent recommended extension of undergraduate courses from four years to five or more. See Table 4 on page 980.

Ending the Shortage

Many thought higher salaries would help to end the shortage of engineers, but even more thought the answers lay in relieving the engineer of routine details that can be assigned to less highly trained technicians. The vote was 26 per cent for the former solution and 34 per cent for the latter. Twenty-two per cent suggested a better job of selling the profession to young people. Six per cent said they doubted the existence of an engineering shortage, and three per cent thought the problem would be solved by leaving it to the law of supply and demand, or by operation of the free enterprise system. See Table 5 on page 980.

1956 ASME Power Show Adds New Sections to Widen Scope

Additional sections of displays have widened the scope of the 22nd National Exposition of Power and Mechanical Engineering, which will make its first appearance in the New York Coliseum after a four-year absence from the city where it was first held, 34 years ago. The exposition continues under the auspices of The American Society of Mechanical Engineers, and will be simultaneous with the Society's 76th Annual Meeting, November 26–30.

Rockets and Missiles Section

A Rockets and Missiles Section will be added to the Power Show, sponsored by the American Rocket Society, whose annual meeting will be held during the same week at the Henry Hudson Hotel, opposite the Coliseum. This display marks the new and objective course of guided-missile development that has recently emerged from the speculative work in rocketry that has been going on during the decade and more of ARS activity.

Atomic Section

In the atomic section of the exposition, significant exhibits continue to be enrolled. This also is a new feature in the exposition, which was presaged only four years ago by a single display modeling a proposed reactor that had not yet been built. The atomic section now includes a number of exhibits that testify to the rapid advance of nuclear engineering from the speculative aspect into the areas of commerce in power generation and in tracer chemistry, as well as its rapid extension in educational fields.

Noteworthy will be a scale model of the first nuclear reactor to be built in the Far East. This represents a 50-kw solution-type research reactor to be constructed for the Atomic Energy Research Institute of Japan, near Tokyo, early in 1957. It will be employed for studies in botany, biology, agriculture, materials research, production of radioisotopes, and student training, as well as general research in nucleonics. This unit will be similar to the reactor built in Chicago, Ill., for Armour Research Foundation.

At the same display, information will be available relative to other aspects of the exhibitor's extensive operations under the vast program of the Atomic Energy Commission, including a small experimental unit at the National Reactor Testing Station in Idaho; part of the organic-moderated reactor experiment (OMRE). Contingent on the outcome of this project will be the completion next year of the 12,500-kw reactor-generator at Piqua, Ohio.

The same exhibitor is also engaged in developing a 75,000-kw electric-power reactor plant for the Southern California Edison Company, adjacent to the AEC sodium-reactor experiment (SRE), which itself will produce the equivalent of 20,000 kw of power in the form of heat.

Among other exhibits in the atomic section will be a model of the first privately financed critical facility, and an environmental test capsule, said to be the only one available which controls temperature accurately in reactor environment.

Materials and Equipment

In its general scope, the exposition will scan the entire panorama of materials and equipment for the production, distribution, and application of power, together with power uses in mechanical engineering. It will range over the manifold details of new treatments and devices for the assimilation of fuel, its transformation into heat and power, the application of the several forms of energy in mechanical processes and machines.

Classifications of exhibits take in the package boiler, as well as the complex of separate units that are integrated into the massive concept of the generating station. They cover unit machine-tool operations, as well as full-scale manufacturing in planning its construction and operation.

Electrical Apparatus

In the comprehensive array of electrical apparatus, the long-life expectancy, high efficiency, and inherent voltage stability of a Germanium dc power-supply system, said to be (plus/minus) 1 volt from no load to full load, will be noted; also a line of "in-between" sizes of magnetic controls, permitting starter and motor to be matched; as well as "one coil that takes the place of six"—a dual-voltage coil that is moisture and fungusproof, noncombustible and impervious to puncture. There will also be a new reversing motor that sets new standards for rapid reversing of machine tools.

Super-pressure vented float traps for handling hydrocarbons in a wide range of specific gravities will be featured in one instance; in another, a rotating steam trap shown in conjunction with a line of dial thermometers and temperature regulators for the control of any type of solution.

Along with the varied assortment of raw and fabricated materials will be an exhibit portraying alloys which make possible more efficient power generation at higher temperatures, including special alloys for high temperature bolting and turbine blading, other alloys for high-temperature steam lines; also cupronickel tubing for high-pressure feedwater heaters, and applications of austenitic iron.

An electrode boiler for process-steam generation at 15–500 psi, in units of 2 to 60 hp, will be exhibited along with equipment for steam-jet cleaning and also for heating dies and molds for forming plastics, magnesium, and titanium.

As in previous years, the exposition will be open to visitors by invitation and registration only. The general public will not be admitted. E. K. Stevens, president of the International Exposition Co., is Power Show manager.

1600 Student Engineers Turn Out for 12 ASME Regional Conferences

Excellent papers highlight conferences replete with social events and inspection trips

TWELVE Regional Conferences were held across the country by the Student Branches of The American Society of Mechanical Engineers during April and May of this year, attracting large audiences. More than 1600 student engineers traveled, some from quite distant points, to participate in their regional annual meetings. Several conferences reported a record attendance for the past five years.

Designed to give the student members an operational idea, in some measure, of what the Society's Annual Meeting contributes to the general membership, the student conferences follow a comparable format. Students present technical papers before their fellows; they hear lectures by outstanding educators, industrialists, and practicing engineers; they are hosts, or guests, as the case may be, at social events; and they are taken on conducted inspection tours of industrial plants as well as the various types of laboratory facilities maintained at the host university.

Over the years, since the first student conference, the consensus has been that the greatest benefits derive from the acquaintances made, the closer relation of the students to the Society, and the excellent quality of the student papers. Prizes are awarded to the students delivering the best papers; to the university with the largest attendance, other than the host school; enrollment of the largest percentage of potential members; and the greatest number of man-miles traveled. There were door prizes ranging from "Mark's Handbook" and an isometric drawing set, to key chains. Technical literature is supplied by local industries for distribution among the conferees.

Lectures and Inspection Trips

Interesting speakers at the luncheons and banquets included eminent scientists and engineers, as well as college professors, who spoke on many subjects ranging from solar eclipses and weather control to the writing of technical papers. In Region II a movie made by the student branch was shown: "A Day in the Life of a CCNY ME."

Almost every Region held inspection trips. There were tours of the campus, with emphasis on the laboratory facilities and shop areas, visits to nearby electric plants and industrial plants; a trip to an automobile show and a brewery.

Students Report

The students report exceedingly well-attended branch meetings during the year. Some stated there was generally an attendance of over sixty students. There have been greater enrollment figures and much more activity in the branches. It also was reported that ASME Student Branches are holding their own in competition with other technical and professional societies. In most schools ASME is the strongest society represented.

Some suggestions were made to bring out more students to the regional conferences. Interesting speakers on important phases of engineering, engineering history, or current events as they affect engineering, never fail to bring out a good audience. Advertising the event on the campus also is a help! Expenses for traveling should be cut down and students should be accommodated at fraternity houses or in college dormitories where and whenever possible. Some suggested having the conferences in March so that more senior students could attend.

The new Student Branch Program was discussed thoughtfully and carefully. A report of the program will be published in the November issue of MECHANICAL ENGINEERING.

Campus Reports

The small mechanical-engineering departments seem to maintain a higher level of interest in the Society than the large ones, according to several reports. To encourage the larger schools to greater activity, it was suggested that there be more co-operation on the part of the Student Branch Committee and the Sections. Not enough Student Members are transferring to Associate Members in the Society, and of those who do, approximately 40 per cent drop out within five years. It is significant that the Associate Members who are active in the Sections do not drop their membership.

Faculty Advisers and Student Councilors

The Faculty Adviser can do wonders in arousing interest in ASME. He can increase the membership and promote student transfers. He must himself be a Member of the Society and interested and well informed on the advantages of membership in a professional society so he can give the proper guidance. The Student Councilor seems to be helping considerably. The appointment of a councilor should be made carefully by the Section for he is actually a salesman for the Society. He should be an example of the successful engineer and member of ASME who takes an active role in the Society's affairs. One region suggested that Old Guard members could effectively supplement the activities of the regularly appointed councilor.

Although there should be student control of the Branch, guidance and education are needed and can be supplied by the advisers and the councilors. The attitude of "What can I contribute to my profession," rather than "What can I get out of this" must be brought about by a process of education.

Recommendations

The general membership should take a greater personal interest in the Student Branches. The Branches should be kept informed of Section activities and, when feasible, asked to participate.

Contests for technical papers should be sponsored at the schools in the Section. Conferences should be sponsored in the fall for the new officers of the Student Branches, to establish better liaison between the officers and the Society. There could be more talks on the history, growth, and advantages of Student and Associate Membership in the Society. Associate Members should be appointed to committees whenever possible—the active members do not drop out of the Society.

A Student Councilor should be appointed who is intensely interested in ASME and is himself an outstanding engineer. The councilor system seems to be working out where it is in operation. He should help develop the professional attitude through education and guidance. "The services and opportunities provided by the engineering society should be of such quality that faculty members, in company with all other engineers, actively would seek membership," said one Faculty Adviser.

1956 ASME Regional Student Conference Winners

REGION I, NEW ENGLAND, BROWN UNIVERSITY, PROVIDENCE, R. I., APRIL 13–14, 1956

Attendance: 201 Papers Presented: 10

Prize	*Recipient*	*Title of Paper*	*College*
First	Thomas L. Tyler	The Combustion of Uniform Suspensions	Dartmouth College
Second	Fred Joest	A Simple Tachometer for Spark-Ignition Engines	Brown University
Third	Nicholas R. Daum	An Analytical Method for Determining the Bending Stress Due to Gas Loads on Unshrouded Turbine Blades	University of Connecticut
Fourth	Leslie R. Parker	Design for an Extreme High-Temperature Furnace	Rensselaer Polytechnic Institute

REGION II, EASTERN, CITY COLLEGE OF NEW YORK, NEW YORK, N. Y., APRIL 19, 1956

Attendance: 197 Papers Presented: 5

Prize	*Recipient*	*Title of Paper*	*College*
First	Jerome M. Cook	The Result of Silicon Purification	City College of New York
Second	Hans E. Pawel	Temperature Behavior of Aerial Apparatus Housing	Newark College of Engineering
Third	Jeffrey H. Broido	Noncircular Gearing	Columbia University—Mechanical
Fourth	Robert E. Huber	The "M" Combustion Chamber	New York University

REGION III, ALLEGHENIES, SYRACUSE UNIVERSITY, SYRACUSE, N. Y., APRIL 19–21, 1956

Attendance: 108 Papers Presented: 11

Prize	*Recipient*	*Title of Paper*	*College*
First	John E. Waldo	Problem of Water Removal From Modern Aircraft Fuels	University of Maryland
Second	Conrad J. Herold	Damped Vibration of Bars as Index of Damping Capacity of Materials	Johns Hopkins University
Third	Barry J. Dyer	Advanced Ski-Lift Design	Cornell University
Fourth	Joseph F. Fernandes, Jr.	An Emergency Clutch Release for Tractors	Lafayette College
Fifth[1]	David Margolis	Solution of Elementary Stress Problems by Photoelastic Methods	Drexel Institute of Technology

REGION IV, SOUTHERN, CLEMSON AGRICULTURAL COLLEGE, CLEMSON, S. C., MARCH 23–24, 1956

Attendance: 116 Papers Presented: 12

Prize	*Recipient*	*Title of Paper*	*College*
First	Eliot T. Pyles, Jr.	Porous Chromium in Cylinders	University of Tennessee
Second	Miss Mia Canariis	Correlation of Audible Sound and Pressure Pulse of Detonation in an IC Engine	Vanderbilt University
Third	John E. Tennant	Report of Investigation of Fly Ash for Pozzolans in Concrete	University of South Carolina
Fourth	J. Ralph Reid	The Significance of Thermal Stresses in Design	University of Alabama
Fifth[1]	Robert G. Jones	A New Drilling Machine	Mississippi State College

REGION V, MIDWEST, MICHIGAN STATE UNIVERSITY, EAST LANSING, MICH., APRIL 27–28, 1956

Attendance: 167 Papers Presented: 14

Prize	*Recipient*	*Title of Paper*	*College*
First	Franklin L. Erwin	A Mechanical Engineer Gets A Job	Carnegie Institute of Technology
Second	James C. Haney	The Determination of the Velocity of a Polyethylene Pellet	West Virginia University
Third	John E. Hodel	Design of an Intermittent-Motion Mechanism for a Flight-Line Recorder	Ohio State University
Fourth	Arnold Field	Electrostatic Spray Painting	University of Toledo
Fifth[1]	Anthony Burdo	Titanium	Michigan State University

REGION VI, NORTHERN TIER, NORTH DAKOTA STATE COLLEGE, FARGO, N. DAK., APRIL 20–21, 1956

Attendance: 100 Papers Presented: 10

Prize	*Recipient*	*Title of Paper*	*College*
First	Joseph G. Murray	Thrust and Drag Forces in Three Basic Types of Jet Engines	University of Wisconsin
Second	Mack Suliteanu	Materials Handling in a Small Sheet-Metal Shop	Illinois Institute of Technology
Third	Wayne J. Severson	Engineering Education	South Dakota State College
Fourth	Bayard T. Horton, Jr.	Production With Shell Molding	University of Minnesota

REGION VI, SOUTHERN TIER, MISSOURI SCHOOL OF MINES AND METALLURGY, ROLLA, MO., HELD AT ROOSEVELT HOTEL, ST. LOUIS, MO., APRIL 26–27, 1956

Attendance: 153 Papers Presented: 13

Prize	*Recipient*	*Title of Paper*	*College*
First	Jamshed A. Modi	Liquefaction of Helium by the Joule-Thomson Process	Purdue University
Second	Samuel A. Gulotta	The Roll-Bond Process	Missouri School of Mines and Metallurgy
Third	Richard P. Carroll	Teaching the Whirly Bird to Behave	University of Notre Dame
Fourth	Albert W. Black	Drag Determinations of Automobiles by Wind-Tunnel Methods	Washington University
Old Guard[1]	Donald H. Hansen	Problems and Techniques in Deep Drawing of Aluminum	State University of Iowa

REGION VII, PACIFIC NORTHWEST, STATE COLLEGE OF WASHINGTON, PULLMAN, WASH., MAY 3–4, 1956

Attendance: 110 Papers Presented: 11

Prize	*Recipient*	*Title of Paper*	*College*
First	Arthur J. Bowker	The Use of the Pipe Elbow as a Flow-Measuring Device	University of British Columbia
Second	James H. VanSant, Jr.	Variable Venturi Carburetor	University of Idaho
Third	Fuat Turanciol	Centrifugal Jet Engine	University of Washington
Fourth	Frederick P. Wahlquist	Automatic Leveling Control for the John Deere Combine	University of Idaho

[1] Contributed locally.

REGION VII, PACIFIC SOUTHWEST, CALIFORNIA INSTITUTE OF TECHNOLOGY, PASADENA, CALIF., MAY 3–5, 1956

Attendance: 97 Papers Presented: 11

Prize	*Recipient*	*Title of Paper*	*College*
First	Owen C. Barker	The Design of Internal-Combustion Engine Producing Direct Hydraulic Power	University of Utah
Second	Jerold L. Swedlow	Contour Traveling Without Surveying	California Institute of Technology
Third	Jan L. Arps	Black Gold From Blue Sea	California Institute of Technology
Fourth	Joseph G. Marvin	Pneumatic Conveyance of Spherical Particles	University of Santa Clara

REGION VIII, NORTHERN TIER, UNIVERSITY OF KANSAS, LAWRENCE, KAN., APRIL 23–24, 1956

Attendance: 118 Papers Presented: 11

Prize	*Recipient*	*Title of Paper*	*College*
First	Glen R. Horton	Film Cooling of Gas-Turbine Blades	Kansas State College
Second	Victor R. Schuelein	Is That So?	University of Oklahoma
Third	Roland N. McDaniel	A Thermal Lag Meter	Kansas State College
Fourth	M. W. Sullenberger	Remote Control of Compressor Stations	University of Oklahoma
Fifth[1]	Max M. Spencer	The Problem of Fatigue Failure	Oklahoma A&M College

REGION VIII, SOUTHERN TIER, A&M COLLEGE OF TEXAS, COLLEGE STATION, TEXAS, APRIL 27–28, 1956

Attendance: 132 Papers Presented: 11

Prize	*Recipient*	*Title of Paper*	*College*
First	Joseph W. Jacobson	Metallurgical Yield-Stress Observation	University of Texas
Second	James R. Blanke	Solar Heat Pump	University of Texas
Third	Miss Judith A. Fuller	Effects of Compacting Pressure on Diffusion Rates in Powdered Metals	Rice Institute
Fourth	Jose R. Castillo	On the Solution of a Two-Dimensional Steady-State Heat Problem	A&M College of Texas

REGION VIII, ROCKY MOUNTAIN TIER, COLORADO SCHOOL OF MINES, GOLDEN, COLO., APRIL 20–21, 1956

Attendance: 82 Papers Presented: 13

Prize	*Recipient*	*Title of Paper*	*College*
First	Kenneth W. Maxwell, Jr.	In Situ Combustion Thermal Oil-Recovery Process	Colorado School of Mines
Second	Robert L. Ammons	Guidance	New Mexico College of A&M
Third	George L. Neal	Economic Hard Facing With Cast-Iron Electrodes	University of Denver
Fourth	Arlyn F. Winemiller	A Dual-Oscilloscope Method of Providing a P-V Diagram	Colorado A&M

Prizes, Other Than for Papers, Presented at Student Conferences

1 Two prizes of $25 and $15 were awarded at each Conference to the Student Branches, other than the host college, having the largest and next largest percentage of Student Members attending.

2 A Certificate was presented at each Conference to the Student Branch having the largest percentage of potential Student Membership in the third through sixth years among Student Branches participating.

3 Each Conference presented a Man-Mile Trophy for the Student Branch that traveled the greatest number of man-miles to the Conference. The winners are listed in the following table:

Region	*$25*	*$15*	*Potential Student-Membership Certificate*	*Man-Mile Trophy*
I	Worcester Polytechnic Institute	Northeastern University	University of New Hampshire	Norwich University
II	Newark College of Engineering	Pratt Institute-Polytechnic Institute of Brooklyn	Newark College of Engineering	Newark College of Engineering
III	Howard University	University of Delaware	Catholic University of America University of Delaware Swarthmore College	Howard University
IV	University of South Carolina	University of Tennessee	University of South Carolina	University of South Carolina
V	University of Dayton	Carnegie Institute of Technology	University of Dayton	Carnegie Institute of Technology
VI—Northern Tier	University of North Dakota	South Dakota School of Mines	University of North Dakota	South Dakota School of Mines
VI—Southern Tier	University of Louisville	Rose Polytechnic Institute	University of Illinois-Navy Pier Div.	Rose Polytechnic Institute
VII—Pacific Northwest	Oregon State College	Montana State College	University of British Columbia	Oregon State College
VII—Pacific Southwest	University of Utah	University of Santa Clara	University of Nevada	University of Utah
VIII—Northern Tier	Kansas State College	University of Oklahoma	Kansas State College	University of Oklahoma
VIII—Southern Tier	Texas Technological College	Southern Methodist University	Louisiana Polytechnic Institute	Texas Technological College
VIII—Rocky Mountain Tier	University of Denver	University of Wyoming	University of New Mexico	University of New Mexico

1957 Mechanical Catalog Ready for Distribution

DURING the month of October ASME Members who requested a copy of the Mechanical Catalog will receive the new edition.

Designed as an aid in specifying and buying functions, it contains 50,000 listings, 5095 products of 3500 manufacturers plus over 320 pages of descriptive matter of importance to the engineer in industry.

Since 1912 the Mechanical Catalog has become an invaluable reference for engineers in industry. Constant editing of listings, industry-inspired phraseology revisions and a continuing flow of suggestions from industry have helped make the Catalog the most valuable of its kind.

One important feature of the 1957 edition is the 20-page descriptive listing of all ASME publications, which enables engineers to quickly check their requirements for the latest standards and codes as well as other special data

ASME Coming Events

Oct. 8–10
ASME-ASLE Third Lubrication Conference, Chalfonte-Haddon Hall, Atlantic City, N. J.
(Final date for submitting papers was June 1, 1956)

Oct. 24–25
ASME-AIME Joint Fuels Conference, Sheraton Park Hotel, Washington, D. C.
(Final date for submitting papers was July 1, 1956)

Nov. 25–30
ASME Annual Meeting, Hotel Statler; National Power Show, Coliseum, New York, N. Y.
(Final date for submitting papers—was July 1, 1956)

March 10–16, 1957
EJC Nuclear Engineering and Science Congress, Convention Hall, Philadelphia, Pa.
(Final date for submitting papers—Nov. 1, 1956)

March 18–21, 1957
ASME Gas Turbine Power Conference, Hotel Sheraton-Cadillac, Detroit, Mich.
(Final date for submitting papers—Nov. 1, 1956)

March 27–28, 1957
ASME Engineering Management Conference, Hotel William Penn, Pittsburgh, Pa.
(Final date for submitting papers—Nov. 1, 1956)

April 8–10, 1957
ASME Spring Meeting, Hotel Dinkler-Tutwiler, Birmingham, Ala.
(Final date for submitting papers—Dec. 1, 1956)

April 22–24, 1957
ASME Instruments and Regulators Conference, Northwestern University, Chicago, Ill.
(Final date for submitting papers—Dec. 1, 1956)

April 25–26, 1957
ASME Railroad Conference, Hotel Sheraton, Chicago, Ill.
(Final date for submitting papers—Dec. 1, 1956)

April 25–26, 1957
ASME Management-SAM Conference, Hotel Statler, New York, N. Y.
(Final date for submitting papers—Dec. 1, 1956)

May 19–23, 1957
ASME Oil & Gas Power Conference, Kentucky Hotel, Louisville, Ky.
(Final date for submitting papers—Jan. 1, 1957)

June 9–13, 1957
ASME Semi-Annual Meeting, Sheraton-Palace Hotel, San Francisco, Calif.
(Final date for submitting papers—Feb. 1, 1957)
(For Meetings of Other Societies, see page 992)

ASME Codes and Standards Workshop

New Chairman for Code for Mechanical Power-Transmission Apparatus

E. C. RATH, Power-Transmission Council, New York, N. Y., has been appointed chairman of Sectional Committee B15, Safety Code for Mechanical Power-Transmission Apparatus. Mr. Rath, formerly secretary of the Committee, replaces D. C. Wright, who has resigned due to illness.

Standards and Codes Awards

The ASME Council has approved presentation of a Certificate of Award to two recently retired members of the ASME Boiler and Pressure Vessel Committee and to two members active in the standards field. They are:

C. E. BRONSON, Mem. ASME, retired member of the ASME Boiler and Pressure Vessel Subcommittee on Heating Boilers, after 21 years as a member and nearly 40 years of association in the work of the Committee. Mr. Bronson contributed heavily in the development of the Code for Low-Pressure Heating Boilers.

WILLIAM FERGUSON, Mem. ASME, retired member of several ASME Boiler and Pressure Vessel Subcommittees over a period of about 20 years, also is the retired chairman of the Uniform Boiler and Pressure Vessel Laws Society. Mr. Ferguson is well known and highly respected, from one end of the country to the other, due to his constant travels in presenting the case for safe boiler and pressure vessel construction.

H. W. ROBB, Mem. ASME, is chairman of Sectional Committee B18, Standardization of Bolts, Nuts, Rivets, Screws, and Similar Fasteners. He also is a member of the following sectional committees: B1, Screw Threads; B2, Pipe Threads; B4, Limits and Fits; B6, Gears; B27, Plain and Lock Washers; B32, Wire and Sheet-Metal Gages; B46, Surface Roughness, Waviness, and Lay; and Y32, Graphical Symbols. He is presently a member of numerous subcommittees and technical committees under these and other sectional committees sponsored by the Society. He is currently a member of the ASME Board on Codes and Standards and has been chairman of the Standardization Committee.

JOHN I. YELLOTT, Mem. ASME, in appreciation of his outstanding leadership in the development of standards and codes sponsored by the Society, also was a recipient of a Certificate of Award. He has given faithful service to the Society in his work on Power Test Codes committees. In 1946 Mr. Yellott was appointed a member and chairman of PTC Committee No. 22 on Gas Turbines and in 1949 was appointed to the standing Power Test Codes Committee.

ASME Codes and Standards Abroad

In response to several recent requests from other organizations for permission to translate into foreign languages codes and standards for which the Society holds the copyright, the Board on Codes and Standards has adopted a policy under which such requests may be granted. The basic provisions are: The translation shall be at no expense to the Society; each translated document shall state, in a prominent place on the cover and inside, the complete designation, both in English and the language into which it is translated; and a statement shall be made to the effect that only the original English text is officially recognized.

This evidence of interest in ASME documents is indicative of the attention with which foreign manufacturers are following trends in American industry.

Japanese Standards Delegation Visits ASME

On August 17 the ASME was host to a team of Japanese engineers visiting in this country to study standardization activities. This group of 13 prominent engineers and industrial executives with their two interpreters made up a team sent out from the Japanese Productivity Center to study subjects relating to standardization, simplification, and specialization in industry.

During the course of the day, presentations were made by ASME committee and staff members on the standardization activities of the Society, specifically covering Boilers and Pressure Vessels, Safety Division, Power Test Codes and Standardization, and particularly those relating to ASME's role as sponsor for many ASA projects. The team expressed special interest in the work that has been done on the measurement of surface roughness. At the close of the all-day session the visitors expressed themselves as highly satisfied and most appreciative of the Society's hospitality.

The Japanese team personnel was composed of the following: Meitatsu Takamine, *Leader*, vice-president, Japan Standards Association; Hidehiko Higashi, *Secretary*, Aeronautical Section chief, Standards Division, Agency of Industrial Science and Technology (Japanese Government); Masahei Imatomi, superintendent, production department, Yawata Steel Works; Eiichi Ishii, chief, purchases and stores department, Japanese National Railways; Toshio Ito, general manager, Japan Productivity Center; Takeo Kato, member, board of directors, Mitsubishi Electric Manufacturing Company, Ltd.; Ushijiro Kurachi, director and chief, research department, Shimizu Construction Company,

Ltd.; Naoshi Machida, chief, Control Division, Administrative Control Agency (Japanese Government); Kazuo Maeda, member, Grievances Committee, Mitsui Shipbuilding Labor Union of the All Japan General Federation of Shipbuilding Workers (Zen-Zosen Soren); Takasuke Nakayama, deputy chief, Financial Division, Nippon Electric Company, Ltd.; Takesaburo Sato, director and president, Shibaura United Engineering Company, Ltd.; Kuhachi Sunami, president, Federation of Specialty Stores Association of Japan; and Kiyotami Toyofuku, managing director, Uraga Dock Company, Ltd.

Code for Pressure Piping—Case No. 24

Pending the publication of a new edition of Section 8, Gas Transmission and Distribution Piping Systems, of the Code for Pressure Piping, the following changes are hereby in effect:

Paragraph 824.23: Delete the words "and hardenability" in the third sentence.

"Alloy steels having weldability characteristics demonstrated to be similar to these carbon steels shall be welded, preheated, and stress relieved as prescribed herein for such carbon steels."

Paragraph 831.22: ASTM Specification A354 Quenched and Tempered Alloy Steel Bolts and Studs with Suitable Nuts is approved as an additional material where ASTM A193 is now listed.

ASTM Specification A325 Quenched and Tempered Steel Bolts and Studs with Suitable Nuts and Plain Hardened Washers is approved as an additional material where ASTM A261 is now listed.

Paragraph 841.16 (f): Change the word "moisture" to "water" in the second and the last sentences.

Paragraph 841.262: Delete the present wording and substitute the following new requirement:

"Electrical test leads may be attached directly on to the pipe by the thermit welding process using aluminum powder and copper oxide provided the charge is limited to No. 15 (15 gram) cartridges and the size of electrical conductor restricted to No. 6 AWG or smaller. Where the application involves the attachment of a larger wire, use a multistrand conductor and rearrange the strands into groups no larger than No. 6 AWG and attach each group to the pipe separately, using a No. 15 (15 gram) cartridge of powder. Attaching electrical test leads directly onto the pipe by other methods of brazing is prohibited."

Paragraph 845.21: Change the word "are" to "include" in the first sentence.

"Suitable types of protective devices to prevent overpressuring of such facilities include:"

Paragraph 845.32: Change the word "are" to "include" in the second paragraph.

"Suitable types of protective devices to prevent overpressuring of a high-pressure distribution system include:"

Paragraph 845.42: Change the word "are" to "include" in the second paragraph.

"Suitable types of protective devices to prevent overpressuring of low-pressure distribution systems include:"

Paragraph 845.62: Delete the last sentence and substitute new wording. Paragraph will read:

"The discharge stacks, vents, or outlet parts of all pressure-relief devices shall be located where gas can be discharged into the atmosphere without undue hazard. Consideration should be given to all exposures in the immediate vicinity. Where required to protect devices, the discharge stacks, or vents, shall be protected with rain caps to preclude the entry of water."

Paragraph 849.1 (a): Delete the present wording entirely and substitute the following:

"(a) Vaults and pits shall be designed and constructed in accordance with good structural-engineering practice to meet the loads which may be imposed upon them."

Code for Pressure Piping—Case No. 25

Inquiry: Paragraph 841.432 literally interpreted could imply a degree of perfection not attainable with even the most modern equipment. What constitutes compliance with this requirement?

Reply: It is the opinion of the committee that the practical limitations of modern equipment shall be given proper consideration. This section requires the exercise of responsible and experienced judgment rather than numerical precision.

Engineering Societies Personnel Service, Inc. (Agency)

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4 50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Sales Manager, ME, MBA, 30, seven years' experience in industrial engineering, mill management, and sales with leading textile concern. ME-333.

Assistant Plant Engineer, BME, 36; PE license, three years supervision and administrative duties, all phases plant engineering, including estimating, planning, and execution of layouts. Six years engineering, design, and layout of process and material-handling equipment, piping, and plant utilities, and administrative duties. Prefers metropolitan N. Y. or N. J. area. ME-334.

Mechanical Engineer, BME, MME, 28; desires Europe only. Three years inspection, supervision, and testing of field erection of machinery, equipment, piping. Two years chemical-process and oil-refinery design and stress analysis of piping and equipment. Two years (now supervising 14 engineers) design and stress analysis gas-turbine engines. ME-335.

Top Management or Executive Assistant, BS and MME, 35; eight years with consulting engineers, designing large steam-power stations. Has business-administration and industrial-engineering background and interests. Desires management position with challenge and responsibility, preferably in medium-sized manufacturing company. Prefers West or Midwest. ME-336-552-Chicago.

Mechanical Engineer, PE, 35; MSE graduate study business administration. Line and staff experience; industrial engineering, production, maintenance, metallurgy, cost control, and reduction. Desires administrative assistant or departmental administration. Prefers southern United States. ME-337.

Mechanical-Industrial Engineer, BSME, MSIE, PE, 35; six years in tooling, processing, product design, and plant industrial engineering. Desires responsible position in staff or consulting field; overseas, Midwest, or West. ME-338-Detroit.

Mechanical Engineer, MS (ME), 29; five years application and sales of mechanical equipment, project co-ordination, preparation of technical proposals, special analytical projects. Prefers New York City. ME-339.

Mechanical Engineer, SB (ME), 23; three years' experience in military aircraft, primarily hydraulics and pneumatics; six months in packaging machinery. Capable of assuming responsibility. Desires East. ME-340.

[1] All men listed hold some form of ASME membership.

Positions Available

Manufacturing-Engineering Manager, for manufacturer of precision-metal parts, 33–45, with mechanical or industrial-engineering degree. Must have good background in tooling. Will re-

port to vice-president in charge of staff of about 50 people, which will include chief industrial engineer and chief production engineer. Will be responsible for administration, tool-and-equipment-design engineering activities, and coordination of plant engineering. $12,000–$20,000, plus all fringe benefits. East. W-3187. Reopened.

Operations-Standards Engineer, civil, mechanical, or industrial graduate, for administrative and management work on reviewing plans, better layout, materials, estimating operational costs, maintenance schedules, etc. $6000–$9500. New York, N. Y. W-3766.

Senior Industrial Engineer, 35–45, for central administrative staff, to co-ordinate all management services including control, finance, product divisions for manufacturing company. $12,000. Texas. W-3791.

Executive for Office-Appliance Manufacturer, to 45, either ME or degree in business administration, or both; experience in the manufacture and distribution of office machines with emphasis on building national dealer-distributor organization. Must have demonstrated ability and capacity in sales organization and administration. $25,000–$30,000, depending upon experience and past earnings. East. W-3794.

Chief Engineer, graduate mechanical, with managerial and administrative background, to head up a department of 120 engineers for manufacturer in the small engine field. $25,000–$35,000. Calif. W-3813.

Industrial Engineer, woolen and worsted mill, over 30, either an industrial, textile, mechanical, or electrical engineer possessing a technical knowledge of spinning and weaving operations. Must be capable of installing and operating production planning, including process flow, scheduling material, etc., incentive and bonus plans, production standards, quality control, co-ordinate functions within the mill, etc. Some consulting experience is desirable. $10,000–$12,000. European continent. F-3825.

Paper-Mill Production Expert, over 30, either industrial, mechanical, or electrical engineer, with extensive practical experience in the production and management of paper mills. Must possess sound practical knowledge of all basic production equipment used in modern mills, including cylinder mills, as well as fourdrinier mills, and the sulphate, sulphite, and semichemical processes of pulp production; qualified in the production and production processes of all types of paper board; possess a knowledge of machinery needs and layout of new mills, etc. One of the primary objectives of the study is to make the maximum use of the forest product, extending its usefulness through the economical utilization of reclaimed fibers. $10,000–$15,000 and up. European continent. F-3826.

Design Engineer, Boilers, 30–40, graduate mechanical, over five years' experience in boiler design; experience in materials and thermal design. Will have charge of mechanical design of water-tube boilers in sizes to 100,000 lb per hr; supervise engineering and drafting departments of boiler division. $10,000. Pa. W-3846.

Plant Engineers, BSME, 23–30, two to six years' experience in preventive maintenance, preferably in petroleum refining or petrochemical field, for major petroleum refinery. Company will pay placement fee and certain moving costs. Southwest. W-3847.

Manufacturing Engineer, under 45, graduate mechanical or industrial engineer, fully experienced in mass production of precision-metal parts. Duties will include technical supervision and coordination of production operations, including tooling, methods, cost, and quality control; supervision of foremen and production workers; supervision of plant maintenance. $9000–$10,000, plus liberal benefits. Newark, N. J., area. W-3850.

Personnel Supervisor, mechanical or electrical graduate, at least five years' supervisory staff liaison and recruiting experience in electromechanical-equipment field. $15,000. New York metropolitan area. W-3868.

Mechanical Engineer, 30–50, experience in the design of complex mechanical parts for military electronic equipment. Will direct efforts of draftsmen and modelmakers in the layout and fabrication of parts of his design. Extensive knowledge of materials and finishes. Will supervise tests on completed equipment such as life tests, field tests, and flight tests for operation. $8000–$11,000. Employer will pay fee. Upstate N. Y. W-3878.

Chief Manufacturing Engineer, for an established automotive-parts supplier, 35–55; will assume responsibility for product-cost estimating-(contract items), plant engineering and maintenance, manufacturing methods, labor standards and routings, and tool-and-die design, procurement, and maintenance. Operations utilize small and medium-sized conventional and automatic punch presses, cold-roll forming machines, resistance welders, zinc-plating equipment, and a variety of pneumatic and hydraulic bending, forming, and staking devices. $10,000–$12,000. Ohio. W-3883.

Mechanical Engineers. (*a*) Development engineer, graduate, at least five years' design and development experience covering compressors, pumps, and gas-liquefying equipment. $8000–$9000. (*b*) Sales engineer, graduate mechanical, industrial field-sales experience, to sell gas-liquefying equipment. Some traveling. $8000–$9000, New York metropolitan area. W-3887.

Construction Engineer, BS in mechanical, electrical, or civil, ten years' plant engineering experience (preferably steel, aluminum, or brass mill); five years' supervisory experience. Will plan, estimate, and direct construction projects ranging from small equipment modification to installation of entire metalworking process facilities. Must be able to supervise work of outside contractors to include maintaining schedules and quality of work. $10,000–$12,000. Company will pay one half of placement fee when applicant reports for work; the other half after six months of employment. Will pay expenses for interviews; moving expenses are negotiable. Pa. W-3891.

Sales Engineers, Government, BS in mechanical or chemical engineering, to 40, for engineering sales, to handle leasing agreements and outright sales of oxygen generators and low-temperature processing systems; some experience in industry or government engineering or technical sales desired. Experience in petrochemical, chemicals, or petroleum refining, particularly with respect to light hydrocarbons and low-molecular weight substances normally existing as gases would be useful. Knowledge of government procurement regulations and/or experience in a company which is a government vendor is desirable. To $10,000. Company will pay placement fee. Pa. W-3894.

Patent Attorney, graduate engineer, plus LLB, to establish and direct patent department for domestic and foreign patent work. Must have experience in all phases of patent work including familiarity with Patent Office in Washington, D. C. Will handle all phases of patent work; supervise technical writers and clerical staff; prepare and administer patent-department budget. $8000–$12,000, plus bonus. Ohio. W-3901.

Assistant to Chief of Planning and Estimating, production-engineering division, to do scheduling, follow-up, and co-ordination of production-engineering activities to meet schedule dates and preparation of status reports of all programs. $5400–$8580. Pa. W-3903.

Senior Industrial Engineer, 32–38, engineering degree, at least five years' experience in agriculture and food-process industry including methods improvement, materials handling, and transportation. Knowledge of Spanish desirable. $12,000, with housing and other extras. Caribbean area. F-3906.

Development Engineers, mechanical graduates, under 40, machine-design and development experience in continuous-filament yarn fields. $6000–$9000. Company will pay placement fee. Pa. W-3908(*a*).

Engineers. (*a*) Design engineers, mechanical graduates, under 45, experience in the design of special machinery, preferably related to automation, for design of coil-winding equipment. $8000–$9500. (*b*) Senior design and production engineers, in special machinery fields, to supervise machine construction, scheduling, and staff administration of a development shop. Some travel. To $12,000, excellent opportunity for advancement; expenses paid for interviews; allowances for relocation. Upstate N. Y. W-3920.

Production Engineer, 35–45, mechanical or industrial graduate, at least five years' supervisory experience in production control, scheduling, inventory, and purchasing liaison covering electromechanical instruments, controls, and equipment. $8000–$9500. Mich. W-3923.

Cost Engineer, graduate mechanical or industrial, time study, methods, schedules, and considerable cost-analysis and cost-control experience in machine shop and manufacturing. Position with management consulting firm. Some travel. $7200–$9600. New York, N. Y. W-3925.

Engineering Supervisor, medium-sized firm which essentially does mechanical engineering. Should be experienced in high-pressure steam-power plants and experienced in the design of valves and related boiler auxiliaries for medium and high pressures. Should be familiar with machine-shop practices, good knowledge of metallurgy, and fair knowledge of thermodynamics. Salary open. Pa. W-3930.

Director of Manufacturing, multiplant corporation, to 48, graduate ME, ten to 15 years' experience in manufacture of very heavy capital goods; multiplant executive experience; wide knowledge of steel fabricating, welding, and heavy machine-shop practice in durable goods. Will supervise works managers of individual units in several states. Substantial interplant travel is necessary. $20,000–$25,000. Headquarters, New York, N. Y. W-3939.

Vice-President, Engineering, to 48, preferably MME, to head engineering department of 400; must be registered PE in more than one state. Product engineering in heavy capital goods and heavy ordnance products including tanks, howitzers, etc. Must have 15 to 20 years' engineering experience in heavy durable goods; five to ten years as chief engineer in product engineering. Must be excellent administrator with ability to plan and direct research, development, and engineering programs. $30,000–$35,000, depending on training, experience, personality, and previous earnings. Headquarters, New York, N. Y. W-3940.

Tube-Mill Engineer, 25–40, industrial, metallurgical, or mechanical degree; five to six years' experience in tube-mill operations required. Will supervise tube-mill department consisting of approximately 50 employees, with equipment consisting of draw benches, tube reducer, and associated auxiliary equipment for production of aluminum tubing. Salary open. East. W-3942.

Industrial Engineer, 30–35, graduate, experience in paper industry, preferably in mill and converting operations. $8000–$10,000. Headquarters, New York, N. Y., with trips to plants. W-3945.

General Manager, mechanical-engineering experience covering supervision of special machine equipment, toolings, jigs, and fixtures. $10,000–$12,000, plus bonus. Newark, N. J. W-3946.

Assistant to Vice-President, ME graduate, office engineering, liaison, specification, and field experience in process-industry construction. $7200. New York, N. Y. W-3949.

Mechanical Engineer, 20–34, graduate mechanical, at least one year's experience in drafting or designing; at least two years' experience in mechanical engineering and/or mechanical maintenance in medium or heavy industry. Must be able to co-ordinate work with other engineers and contractors. Pacific Northwest. W-3957(*b*)

Development-Project Engineer, mechanical or electrical graduate, 25–50, at least five years in development or design of electromagnetic or electronic services. Know electromagnetics, electrical circuits, electronics, semiconductors, or mechanics. Will be responsible for planning and co-ordinating major long-range development projects on industrial-controls devices including magnetic amplifier and transistor types. $8500–$12,000. Employer will pay fee. Ill. C-5423.

Application Engineer, mechanical or electrical, 25–45, at least three years in electric-circuitry and control-panel layouts design. Know electromagnetic and electric circuits. Duties will include application of industrial-control devices to meet specific customer requirements including solution of problems; will include water-control systems for automatic machines for a manufacturer of electric controls. $6500–$8500. Employer will pay fee. Ill. C-5426.

Sales-Field Engineer, graduate mechanical, electrical, or industrial, 24–30, experience in customer-contact work. Will make technical demonstrations of measurement-control equipment in customers' plants and write formal reports, conduct evaluating studies when measure and control systems are installed, and instruct customers' personnel in operation and maintenance of equipment; handle service calls in assigned territory, work with sales engineers in completing sale. 50 per cent travel for manufacturer of controls. $4800–$7200, plus bonus and expenses. Employer will pay fee. Ohio. C-5430.

Regional Manager, mechanical or electrical graduate, 35–45, at least five years supervisory and sales of engineered-type products. Knowledge of pneumatic and automatic material-handling equipment. Will be responsible for all regional operations of 11 states covering sales, field engineering, and field instruction handling conveyers, dispatch tubes, pallet loaders, blowers, and cleaning and dryset systems for a manufacturer of pneumatic equipment. $10,000. Employer will pay the fee. Chicago, Ill. C-5433.

Supervisor, Industrial Engineering, industrial or mechanical graduate, at least five years in methods, wage incentives, time-and-motion studies. Will supervise general industrial-engineering functions, including cost reduction, for a manufacturer. $8000–$9000. Employer will pay fee. Northwest Chicago suburb. C-5440.

Candidates for Membership and Transfer in ASME

THE application of each of the candidates listed below is to be voted on after Oct. 25, 1956, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and •Transfers

Arizona

JIMINEZ, RAYMOND J., Phoenix
• MUNDTH, LYMAN K., Phoenix
ORADAT, FRANK R., JR., Phoenix

California

AUSMAN, JOHN S., Garden Grove
• HUDSON, EDWARD D., Fresno
•JOHNSON, JOHN E., Millbrae
KING, WILLIAM C., Glendale
•LANG, PAUL A., Hollywood
LEVIN, EUGENE, Los Angeles
MORGAN, EDMUND R., North Sacramento
• MORISON, JACK R., Millbrae
SMYLIE, ROBERT E., Los Angeles
• WHARFF, PRENTICE C., JR., Lafayette
WILDMANN, MANFRED, Downey

Connecticut

BRONKE, VICTOR, W., Glastonbury
• CHALFANT, ARTHUR I., Portland
CRONSTEDT, VAL, Glastonbury

Delaware

• KEPHART, JOHN T., JR., Wilmington
• PUDER, ROLAND W., Wilmington

Florida

COLE, CHARLES E., Pensacola
JONES, CECIL W., JR., Orlando
MORRISON, HAROLD, Haines City
PEARCH, EDWARD, H., Jacksonville

Georgia

FERREE, RAY J., JR., Atlanta

Illinois

BUSCARELLO, RALPH T., Chicago
CAIN, GERALD F., Chicago
• CLARK, JOHN W., Pekin
DAVIS, WILLIAM J., Chicago
• GLASSCOCK, ELLIOTT M., Chicago
• HUMMEL, HARRY H., JR., Moline
PETRIE, VINCENT F., Chicago
SCOTT, FREDERICK L., Chicago
• WEIGAND, CHARLES G., Chicago

Indiana

RUTLEDGE, FREDERICK M., Michigan City

Iowa

SCHELL, PAUL F., Newton

Louisiana

• COPES, JOHN C., 3RD, Slidell
MADDUX, RAYMOND P., New Orleans
STONE, GERALD A., Shreveport

Maryland

BERTIER, THEODORE L., JR., Glen Burnie
GROSS, WILLIAM E., Joppa
• SEVIER, HORACE A., Baltimore
SPARHAWK, HARRY E., JR., Owings Mills

Massachusetts

AMIDON, CHARLES H., Orange
DELUCA, ROBERT A., Boston
DEPUY, FRANCIS A., Orange
HAJEC, RICHARD G., Dudley
LAMPMAN, JAMES R., JR., Indian Orchard
• RAWDON, ALBERT H., JR., Shrewsbury
• RUBIN, MAURICE L., South Weymouth

• Transfer to Member or Affiliate.

Michigan

BEEBE, DONALD J., Midland
• HAMMITT, FREDERICK G., Ann Arbor
LENZ, ROBERT G., Detroit
WALSH, WILLIAM F., Detroit
WEST, GEORGE L., JR., Ann Arbor

Minnesota

• HAZEIRIGG, ROBERT J., Minneapolis
KO, SHAO-YEN, Hopkins

Missouri

• SILVERSTEIN, SANFORD A., St. Louis

New Jersey

• BLICKMAN, BRUCE B., Weehawken
• MARGOLIES, ROYDON S., Plainfield
• MOSKOWITZ, MURRAY, Roselle
SHEREIKA, EDMUND A., Livingston

New York

• ABBOTT, ROBERT E., Kew Gardens
ARTUSKA, FRANK A., Brooklyn
BALDWIN, ELMER E., Schenectady
BERKOWITZ, MURRAY, Forest Hills
CURRERI, JOHN R., Oceanside
GILLEN, THADDEUS, R., New York
• HADLEY, WILLIAM A., Brooklyn
KEMBLE, EDWARD D., Ossining
KERSTEIN, RICHARD M., New Hyde Park
• LORENZINI, ROBERT A., New York
MATHERS, WILLIAM G., Schenectady
MORSE, EDWIN R., New York
REYNOLDS, EDWARD E., Albany
• ROSS, E. WALTON, Baldwinsville
• SWENSON, CHARLES H., New York
• TIMO, DOMINIC P., Schenectady
YANCHENKO, BASIL J., Auburn

North Carolina

DEVLIN, JOHN R., Greensboro

Ohio

JACKSON, LLOYD R., Columbus
KURUCZ, TIBOR, Perrysburg
LIST, ALVIN F., JR., Akron
• LONG, DAVID M., Toledo
• SIMS, EUGENE R., JR., Lancaster
SPUHLER, PETER A., Cuyahoga Falls

Pennsylvania

DECORSO, S. MARIO, East Pittsburgh
• DUNN, CHARLES W., Feasterville
FITZGERALD, CHARLES W., Franklin
• FLAHERTY, ROBERT, Pittsburgh
• FREDERICK, DARRELL D., Erie
GALLINOWSKI, ERWIN B., Erie
HUNTER, ROBERT H., Cheltenham
KEMENY, GEORGE A., East Pittsburgh
• KOCH, ROBERT M., New Kensington
MANN, AUGUST C., Pittsburgh
• RYDESKI, JULIAN A., Oakmont
SHARP, HOMER E., Philadelphia
SYLVESTER, RUSSELL L., Pittsburgh
WEITZENHOFER, MORTON, Philadelphia

South Carolina

• HILL, FRANK, Greenville

Tennessee

GABBARD, CHARLES H., Oak Ridge
• MITCHELL, THOMAS A., JR., Kingsport

Texas

• CLINE, WILLIAM H., JR., Houston
• COLBY, JOHN H., Houston
GILL, RAYMOND F., Houston
REICH, JOHN A., Beaumont
WHITESIDES, JAMES A., Dallas

Utah

• DIMITRI, PETER, Proud

Virginia

MELTON, CHARLES W., Richmond

West Virginia

• PRECIOUS, ROBERT W., South Charleston

Wisconsin

EHINGER, JOHN, Fort Atkinson
GLEMBIN, JEROME F., Milwaukee
LARSEN, JACOB A., Madison
• LEESER, PAUL J., Fond du Lac
•SCHIPPER, JAMES, Delavan

Foreign

CAMPBELL, JAMES S., Kingston, Ont., Canada
GAMMIE, RONALD M., Kahului, Maui, T. H.
• GRAY, IAN A., South Burnaby, B. C., Canada
KOSTKA, WAL, Toronto, Ont., Canada
LOISEL, MARCEL A., Falcon, Venezuela
• MACLEOD, DONALD, Toronto, Ont., Canada
MOHIDEEN, MOHAMED S., Colombo, Ceylon
PASZYC, ALEKSY J., Vancouver, B. C., Canada
• PROCTOR, CHARLES L., Toronto, Ont., Canada
SHEAFFER, JOHN L., Sydney, Australia
TERRELL, BASIL J., Monkseaton, Whitley Bay England
TIPPETT, WILLIAM H., Melbourne, Australia
TUCKWELL, BERNARD S., Rio de Janeiro, Brazil
WILLIAMS, HOWARD A., Willowdale, Ont., Canada
WYNNE, ROBERT, Dhahran, Saudi Arabia

Transfers from Student Member to Associate Member 111

Obituaries

Archie Stanton Buyers (1886–1956), retired Colonel, United States Army, died June 13, 1956. Born, Sterling, Ill., Oct. 20, 1886. Parents, John and Frances Anna (Galt) Buyers. Education, BS(ME), University of Illinois, 1908; MS(ME), Massachusetts Institute of Technology, 1923; MBA, Graduate School of Business Administration, Harvard University, 1934. Married Edna Girard Tobin, 1920; children, John Francis and Archie Girard Buyers. Before joining the United States Army active service in 1912, Mr. Buyers was instructor of mechanical engineering at the University of Illinois, Urbana, Ill. Military decorations and citations: Army Commendation Ribbon; American Defense Service Medal; American Campaign Medal; Legion of Merit; Victory Medal (World War I); Victory Medal (World War II). Jun. ASME, 1912; Mem. ASME, 1925.

Louis Rosenberg Caplan (1915–1956), vice-president, Parr Engineering Co., Washington, D. C., office, died June 18, 1956. Born, Crewe, Va., Nov. 24, 1915. Education, BS Chemical Engineering, the Johns Hopkins University, 1935. Mem. ASME, 1950. Author of technical publication "Keeping Iron In and Out of Solution," presented at a Maryland-Delaware Water & Sewage Works Assoc. Conference. Also contributing editor to the Modern Marine Engineer's Manual—"Combustion Control Systems." In 1944 he joined the U. S. Sanitary Corps as first lieutenant, rising in rank to Captain; was sanitary engineer, malariologist, chief of Preventive Medicine, Mediterranean Theater of Operations. Received Army Commendation Ribbon. Directed malaria control in Mediterranean Theater in 1946. Survived by wife.

Walter R. Cizmarik (1930–1956), graduate trainee, Industries Group, Allis-Chalmers Manufacturing Co., Milwaukee, Wis., died April 24, 1956. Born, Queens, N. Y., Nov. 19, 1930. Education, BME, College of the City of New York, 1954. Assoc-Mem. ASME, 1953.

George Louis Cotter (1902–1956), director of engineering, Westinghouse Air Brake Co., Wilmerding, Pa., died June 8, 1956. Born, St. Louis, Mo., Nov. 9, 1902. Parents, William and Emma (Wiegreffe) Cotter. Education, BSE(ME), University of Michigan, 1923. Married Lillian Kerr, 1931; children, George L., Jr., Barbara Kay, and Nancy Jane. Jun. ASME, 1924; Mem. ASME, 1945. Held several U. S. patents on air brakes.

Carl Endlein (1909–1956), mechanical engineer, Halsmith Corp., Atlanta, Ga., died July 18, 1956. Born, Elberfeld, Germany, Sept. 29, 1909. Education, ME, Stevens Institute of Technology, 1932. Mem. ASME, 1947. Naturalized U. S. citizen. Specialized in industrial instrumentation. Author of technical articles.

Luke Richmond Hadnot, Sr. (1911–1956), president, Piping and Equipment Co., Inc., Greensboro, N. C., died July 4, 1956. Born, Ful-

lerton, La., Nov. 15, 1911. Parents, John R. and Bertie Alma (Boone) Hadnot. Education, BS(ME), Louisiana State University, 1935. Married Evelyn P. Pryor, 1940; son, Luke R. Hadnot, Jr., Jun. ASME, 1935; Mem. ASME, 1948.

Herbert Henderson (1883–1950), vice-president, engineering department, Gulf Oil Corp., Pittsburgh, Pa., died in 1950, according to a notice recently received at headquarters. Born, Pittsburgh, Pa., Aug. 21, 1883. Education, Western University of Pennsylvania. Jun. ASME, 1914; Mem. ASME, 1916.

Arthur Herbert Hutchinson (1859–1951), died in March, 1951, according to a notice recently received at headquarters. Born, Topeka, Kan., Oct. 28, 1859. Education, attended high school in Iowa and the State Normal School in Vermont. Life Mem. ASME, 1949.

James Lynah (1881–1956), retired vice-president and general manager, Brunswick Marine Construction Corp., Brunswick, Ga., died in February, 1956. Born, Charleston, S. C., Oct. 5, 1881. Parents, John Heyward and Ella Louise (Heyward) Lynah. Education, BS(EE), Clemson College, 1923, 1928; ME, Cornell University, 1905. Married Elizabeth Beckwith, 1905; children, Elizabeth (Mrs. Bronson Rumsey), Marie Glover (Mrs. George Sherrill), and Ella Louise (Mrs. Joseph H. Harrison). Mem. ASME, 1922.

Oscar George Melchior (1898–1956), manager of foreign projects, M. W. Kellogg Co., New York, N. Y., died at his home, Ridgewood, N. J., July 1, 1956. Born, Saarbruecken, Germany, May 18, 1898. Education, BS(ME), Kiel Naval Academy, Germany, 1919; MS, University of Hanover, 1921; and postgraduate studies in chemistry at Rutgers University, 1930 (he came to the United States in 1923). He was associated with the M. W. Kellogg Co. for 27 years. In 1945, during World War II, he served as an Army Colonel in the United States Strategic Bombing Survey in England, France, and Germany. Mem. ASME, 1950. Naturalized U. S. citizen, 1932. Author of technical paper: "Regenerator Internal Lining and Catalytic Piping, Internal Protection." Held patent pertaining to catalytic cracking equipment. Survived by wife, Mrs. Pauline Bennett Melchior; a son, Herbert R., of Ridgewood, N. J.; and two sisters, Mrs. Elsie Kroner of New Hampshire and Mrs. Erna Loeffer of Maine.

George Ross Webber (1928–1956), instrumentation engineer, Carbide & Carbon Chemicals Division, Union Carbide & Carbon Corp., South Charleston, W. Va., died in May, 1956. Born, Philadelphia, Pa., Aug. 14, 1928. Education, BS(ME), Lafayette College, 1952. Jun. ASME, 1952.

Elliott Howland Whitlock (1867–1956), retired, founder and president, Whitlock Manufacturing Co., Cleveland, Ohio, died July 4, 1956. Born, Brooklyn, N. Y., May 5, 1867. Parents, Elisha S. and Sarah J. (Elliott) Whitlock. Education, graduate, Texas A&M College, 1886; ME, Stevens Institute of Technology, 1890; hon. MS, 1933. Married Bertha Elizabeth Adams Wellman, 1907 (died, 1941); stepchildren, S. Knowlton Wellman, Cleveland; Julian A. Wellman, Louisville, Ohio; and Mrs. Hovey T. Freeman, Providence, R. I. He was the Cleveland smoke commissioner, 1925–1930. His work gained wide recognition. He later was a professor of mechanical engineering (research) at Stevens to conduct smoke-abatement problems in the Greater New York area. Mem. ASME, 1901; Fellow ASME, 1936. He served the Society as a director, then called manager, 1913–1916; as a vice-president, 1934–1935. He also served on several committees and was the first chairman of the Standing Committee on Local Sections, which was organized by the Council on Dec. 4, 1914. In 1914–1915, he was president of the Cleveland Engineering Society. With this group, his interest led to his acting as chairman of the Code Committee which has undertaken to assist the City of Cleveland in writing new codes, such as the electrical, plumbing, and refrigeration codes. In 1951 he was made an honorary member of the Cleveland Engineering Society. During World War I he served in France as Lieutenent Colonel in command of the 24th Engineers Regiment. Later he entered the Engineer Officers Reserve Corps with the commission of Colonel and was active in the Fifth Corps area. This duty completed, he joined the Ohio National Guard and had command of the 112th Engineer Regiment of the 37th Division. He resigned this commission when he left the state of Ohio. His inventions include an oil gas producer and a drop-hammer improvement; he held a number of U. S. Patents. Coauthor of "Heat Distribution in Burning Cement Clinkers"; also author of several papers on smoke abatement. Survived by three stepchildren, eight step-grandchildren, and 21 step-great-grandchildren.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Division (no more than three) in which you are interested. Your membership card bears key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you are registered.

Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions enrollment are correct. Please check whether you wish mail sent to home or office address.

Please complete the form below and mail it to: ASME, 29 West 39th Street, New York 18, N. Y.

Please Print

ASME Master-File Information

Date

LAST NAME _____ FIRST NAME _____ MIDDLE NAME _____

POSITION TITLE _____ NATURE OF WORK DONE _____

e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give complete name in full) _____ Division, if any _____

*☐

EMPLOYER'S ADDRESS _____ City _____ Zone _____ State _____

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER; e.g., Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐

HOME ADDRESS _____ City _____ Zone _____ State _____

☐

PRIOR HOME ADDRESS _____ City _____ Zone _____ State _____

*CHECK "FOR MAIL" ADDRESS

Address changes effective when received prior to:

I subscribe to

☐ MECHANICAL ENGINEERING	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Please register me in three Professional Divisions as checked:

☐ A—Aviation	☐ J—Metals Engineering	☐ R—Railroad
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ S—Power
☐ C—Management	☐ L—Process Industries	☐ T—Textile
☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ Q—Nuclear Engineering	

Roundup

Of Current Engineering Events, News, and Comment

E. S. Newman, *News Editor*

EJC Survey of Demand for Engineering Graduates in 1956

EJC-EMC questionnaire to government and industrial organizations

A REPORT presenting the summary and evaluation of a survey conducted by the Special Surveys Committee of Engineers Joint Council with the staff assistance of the Engineering Manpower Commission has been released recently. Conducted during December, 1955, and January and February, 1956, the survey is based on replies to an EJC questionnaire of 414 industrial and governmental organizations. The 414 organizations which comprise the sample on which this study is based employ about 140,000 engineering graduates or about 25 per cent of the estimated engineering graduates in the United States.

Summary and Conclusions

One of the most valuable results of the EJC demand studies has been their usefulness in indicating trends in the employment of engineering graduates. Table 1 presents the information from 1952 through the present year in summary form to indicate the over-all rough trend during this five-year period.

Table 1 Trend of Demand for Engineering Graduates

	Previous Surveys by EJC			Current Survey		
	1952	1953	1954	1955	1956	1956
1 Number of organizations reporting	376	376	377	414	414	414
2 Total engineering graduates employed —January 1	117,586	125,086	124,329	132,140	140,446	140,446
3 Total net accessions calendar year	7500	6692	(Projected) 5254	8306	(Expected) 14,162	(Required) 20,125
4 Total engineering graduates employed December 31	125,086	131,778	129,583	140,446	154,608	160,571
5 Net accessions (per cent of engineers employed on Jan. 1)	6.4	5.3	4.2	6.3	10.1	14.3

Although direct numerical comparisons are not suggested (since the survey samples are not strictly comparable), a comparison of trends is certainly admissible. During 1952 the demand for engineering graduates expressed in terms of percentage of net accessions (the total of all new hires minus all losses) was 6.4 per cent of the engineers employed at the beginning of the year. On the same basis, the demand declined somewhat in 1953 and dropped off further in 1954. This trend was reversed sharply in 1955 with a higher demand for engineering graduates than was encountered in the previous peak year of 1952 and this trend continued at a much more accelerated pace through 1956. The percentage of net accessions in 1956 in terms of expected acquisitions is 10.1 per cent—the highest ever. In terms of required acquisitions, it is 14.3 per cent.

The Reporting Sample

The 414 organizations which supplied usable data for this survey include 363 industrial firms and 51 governmental agencies. The industrial activities employed 111,272 engineers and the government organizations employed 29,174 engineers in federal, state, and local agencies. The returns were classified in accordance with the Standard Industrial Classification Code.

In undertaking its survey of engineering demand shortly after World War II, the Special Surveys Committee of EJC decided that the most practicable basis for measuring such demand was the needs of the responding companies for engineering graduates rather than for individuals to fill engineering positions. This decision stems from the difficulty of defining engineering positions in a wide variety of organizations and the fact that in recent years individuals sought from outside an organization for work requiring engineering knowledge or skill had been very largely graduates, although comparable positions frequently are filled from within the organization by those developing such skills through experience.

On this same basis, the responding organizations had been asked to indicate their total employment of the need for engineering graduates, regardless of expected assignment, recognizing that some may enter upon training for technical supervision or similar fields rather than strictly engineering work.

The total population from which the survey sample is drawn, therefore, is the number of engineering graduates in the country, excluding those who are retired, which at the end of 1955 has been estimated as approximately 560,000 from data of the Commission on Human Resources and Advanced Training—as of 1953 and brought up to date. This compares with the total of about 675,000 individuals classified as engineers in industry, government, and other activities as of the same date estimated from the 1950 census and subsequent additions and losses.

The total number of employees in these organizations at the end of 1955 was 3.5 million or about 7 per cent of the total nonagricultural employment of the country and about 11 per cent of the number in the technical fields of mining, manufacturing, transportation, and Public Utilities and in Government. The number of engineering graduates in their employ was as heretofore mentioned approximately 140,000 of whom 110,000 were industrial companies and 30,000 government agencies. Since this number is about 25 per cent of the estimated number of such graduates in the country, it is clear that these organizations represent a concentration of such men above the average of business, industry, and government, generally.

Summary Data Provided by Responding Organizations

The total number of graduates required by these organizations in the categories covered are shown in Table 2.

In Table 2, the net accession figure represents the final gain (or loss) in engineering graduate manpower.

Further tabular presentation of the data by industry is provided in the appendix of the report and is available upon request. Included is a table on turnover of engineers in 1955 and

Table 2 Summary Data Provided by Responding Organizations

	1955 Actual	1956 Expected	1956 Required
1 Number in organization—January 1	132,140	140,446	140,446
2 Total losses during year (all causes, including military)	11,945	10,828	10,828
3 Employment during year:			
A From current classes:			
a Bachelors	8086	11,343	14,524
b Masters	747	1119	1429
c Ph.D.s	384	600	964
Total	9217	13,062	16,917
B From earlier classes:	9133	9561	11,669
4 Number returning from military leave	1901	2367	2367
5 Total net accessions (3 plus 4 minus 2)	8306	14,162	20,125
6 Number in organization—December 31	140,446	154,608	160,571

the breakdown by industry of the demand figures for 1955 and 1956 and a table on engineering technicians.

Evaluation

The data presented in Tables 1 and 2 clearly indicate a rise in demand for engineering curriculum graduates in 1955 and 1956 substantially above that in any year since 1951. There is little question, therefore, that for now and the immediate future, government, industrial, and other programs affecting engineering graduates should be oriented to and realistically reflect the deficiency indicated.

It is pertinent to ask for the implications of this 1956 survey data for the over-all national, industrial, and governmental demand for engineering curriculum graduates. A projection of the sample based either on known engineering graduate population or engineering employment in industry and government in the United States would unquestionably be misleading because of the presumption that the needs of the sample represented here are relatively greater than the economy as a whole. In addition, any over-all statistical requirement can be related only to a specific point in time and can be effected rapidly by a whole series of factors acting either independently or in concert. For example, there is little indication here that engineering demand is accumulative over the years. Quite obviously, organizations have learned somehow to perform satisfactorily with undercomplements of engineering personnel. Nevertheless, and considering all factors, the data would seem to warrant the assertion that the situation would be considerably eased if the total number of engineering graduates in 1956 were of an order of magnitude between 35,000 and 40,000.

It should be emphasized that this situation does not necessarily have implications for the intermediate future. Looking ahead to the next three years when the size of the graduating class in engineering will average about 35,000 per year, it is pertinent to note that this increase in the size of graduating classes combined with a somewhat reduced technological momentum may have the effect of easing the present situation of extreme shortage. On the other hand, it is clear that given continuing technological activity with a growth factor similar to that of the recent past, there is very little to promise merely numerical relief during the next four years.

AEC Research Reports Available by Categories

Atomic Energy Commission research reports released through the Office of Technical Services, U. S. Department of Commerce, are now available in eight category "packages." This service has been established to meet the demand by scientific and industrial organizations for a bulk purchasing arrangement.

Each package contains all AEC reports in its category available through OTS in full-size, printed copies, as of May 21, 1956. Subject categories and prices are as follows.

Health, Physics, Biology, and Medicine (220 reports)	$ 74
Chemistry (455 reports)	164
Engineering (105 reports)	34
Geology and Mineralogy (144 reports)	42
Instruments (292 reports)	62
Metallurgy and Ceramics (380 reports)	92
Physics (1190 reports)	280
Miscellaneous (55 reports)	23

The prices take into account reduced handling costs made possible by bulk packaging and sale of the documents.

The packaged reports may be purchased from OTS, U. S. Department of Commerce, Washington 25, D. C. Payment may be made in cash, by check, or by drawing upon a deposit account with the Superintendent of Documents. If the last means of payment is used, the purchaser should furnish his account number.

Newly released AEC reports are announced monthly in the OTS-published *U. S. Government Research Reports*, which also lists reports available to the public covering research by other government agencies ($6 a year from the Superintendent of Documents, U. S. Government Printing Office, Washington 25). Reprints of the monthly AEC list from this publication may be ordered at 10 cents each from OTS.

Los Angeles Scene of NCSBEE Meeting, Aug. 23–25, 1956

More than 210,000 professional engineers are now licensed and registered to practice their profession in the United States, Alaska, Hawaii, and Puerto Rico. This fact was reported during the 35th Annual Meeting of the National Council of State Boards of Engineering Examiners in Los Angeles, Calif., Aug. 23–25, 1956, which was attended by 113 delegates from 45 of the 52 member boards.

For the three days of the meeting, in committee and in open business session, the delegates discussed the problems of registration and licensure with which they are faced. The topics included: The form and content of examinations for prospective registrants and for engineers-in-training; methods of improving the National Certificate to facilitate reciprocal registration between states; methods of making the various state laws and procedures more uniform; procedures to give the public a better understanding of the value of the professional engineer to the community; and the relationship of corporate practice to licensing problems.

By this exchange of experience and through the development of mutual respect and confidence between the members of the various boards, it was readily apparent that the Council exerts a profound influence on the registration process throughout the nation.

The list of ASME members who were present and contributed constructively to the discussions included: John M. Gallalee of Alabama, George L. Sullivan of California, Russell G. Warner of Connecticut, Henry D. Watson of Maine, William H. Larkin and Newell L. Freeman of New York, Robert B. Rice of North Carolina, B. G. Dick of Oregon, J. D. Guillemette of Rhode Island, James H. Sams of South Carolina, and W. M. Andrews of Texas.

During the meeting, the examining board of the Panama Canal Zone became a member of the Council, increasing the number to 53.

At the closing banquet President Bruce Williams of Missouri presented certificates for distinguished service in engineering registration to Charles S. Crouse of Kentucky, Clarence L. Eckel, Mem. ASME, of Colorado, John W. Gore of Maryland, J. D. Guillemette, Mem. ASME, of Rhode Island, Allen S. Janssen of Idaho, Junius T. Moore of West Virginia, Stanley G. Palmer of Nevada, and William M. Spann of Missouri. At the banquet the Society was represented officially by J. Calvin Brown, past-president, and C. E. Davies, secretary.

New officers for 1956-1957 were introduced: Edward R. Stapley of Oklahoma, president; Allen S. Janssen of Idaho, president-elect; and Leo M. Odom of Louisiana, E. R. Dodge of Montana as directors. These four with Bruce Williams, L. E. McCartt of Kentucky,

and William H. Larkin, Mem. ASME, of New York, constitute the Board of Directors for 1956-1957. T. Keith Legaré of South Carolina who has served faithfully and well as executive secretary for over three decades continues in that office.

In 1957, the Council meets in Atlanta, Ga., October 31 through November 2, and in 1958, in Milwaukee, Wis., during August.

Meetings of Other Societies

Oct. 15–16
German Association for Noise Prevention, conference on noise caused by jet planes and so on, Munich, Germany

Oct. 16–19
American Society for Testing Materials, fall committee meeting, Warwick Hotel, Philadelphia, Pa.

Oct. 17–19
American Society of Body Engineers, 11th annual technical convention, Rackham Memorial Building, Detroit, Mich.

Oct. 18–19
Institute of Management Sciences, third annual meeting, Hotel Statler, Los Angeles, Calif.

Oct. 18–19
National Conference on Industrial Hydraulics, sponsored by Illinois Institute of Technology, Sherman Hotel, Chicago, Ill.

Oct. 22–24
American Standards Association, 38th annual meeting and seventh national conference on standards, Roosevelt Hotel, New York, N. Y.

Oct. 22–26
National Safety Council, 44th National Safety Congress and Exposition, Chicago, Ill.

Oct. 23
American Society of Safety Engineers, annual meeting, Conrad Hilton Hotel, Chicago, Ill.

Oct. 25–26
Society for Advancement of Management, annual fall conference, Hotel Statler, New York, N. Y.

Oct. 28–31
American Gear Manufacturers Association, semiannual meeting, Edgewater Beach Hotel, Chicago, Ill.

Oct. 31–Nov. 2
Industrial Management Society, 20th anniversary national time and motion study and management clinic, Sherman Hotel, Chicago, Ill.

Oct. 31–Nov. 2
Gray Iron Founders' Society, 28th annual meeting, Homestead Hotel, Hot Springs, Va.

Oct. 31–Nov. 2
Society for Experimental Stress Analysis, annual meeting and exhibit, Deshler-Hilton Hotel, Columbus, Ohio

Nov. 8–9
Society of Automotive Engineers, fuels and lubricants meeting, The Mayo, Tulsa, Okla.

Nov. 12–15
American Petroleum Institute, 36th annual meeting, Conrad Hilton Hotel and Palmer House, Chicago, Ill.

Nov. 12–17
First Western Hemisphere Management Conference sponsored by PACCIOS, the Pan-American Council of the International Committee for Scientific Management, Santiago, Chile

Nov. 14–17
American Society of Naval Architects and Marine Engineers, 64th annual meeting, Waldorf-Astoria Hotel, New York, N. Y.

Nov. 15–16
American Mining Congress, coal division conference, Hotel William Penn, Pittsburgh, Pa.

(ASME Coming Events, see page 985)

Coming Meetings

Air Pollution

A PUBLIC symposium on "Cleaner Air for Urban Areas" will be held at The Franklin Institute, Philadelphia, Pa., on Oct. 15, 1956.

Authorities on air pollution, representing the physical sciences, medicine, engineering, industry, and government will address the one-day symposium. The discussion will be semitechnical, designed primarily to clarify the present approaches to the problem and outline steps that have yet to be taken to ensure cleaner air for our cities.

The symposium will also feature exhibits of equipment used in air-pollution research and control, and a tour of the Institute's air-pollution research laboratory.

Fee for symposium registration will be $15, payable to The Franklin Institute. All mail should be addressed to Cleaner Air Symposium, The Franklin Institute, 20th and Parkway, Philadelphia 3, Pa.

Energy Resources

THE first annual Energy Resources Conference will be held in Denver, Colo., Oct. 29 through 31, 1956. Sponsored by the Natural Resources Council of the Denver Chamber of Commerce, the Energy Resources Conference will bring together leaders in the field of development of our energy resources to study developments in the production of new sources of energy, examine industrial and technological application of energy sources, and to explore their influence upon our future.

The three-day conference will hold formal meetings at the Cosmopolitan Hotel on the first two days and the third day of the meeting will be devoted to field trips to scientific and research centers in the area.

Registration fee for the conference is $35 per person, which entitles the registrant to attend all conference sessions, and covers the cost of luncheons, dinners, the field trips, and entertainment included in the conference agenda. Wives are welcome and urged to attend the conference as an interesting program for the women has been planned including trips to scenic and historic places in colorful Colorado. Women's registration fee is $15.

All persons interested in attending are urged to make reservations as soon as possible with the Energy Resources Conference, c/o the Denver Chamber of Commerce, 1301 Welton Street, Denver 4, Colo.

Management

Two of the world's outstanding women industrial engineers will headline the 20th Anniversary Time and Motion Study and Management Clinic sponsored by the Industrial Management Society to be held at the Hotel Sherman, Chicago, Ill., Oct. 31–Nov. 2, 1956.

America's Dr. Lillian Gilbreth, so-called "mother" of motion study, and England's Anne G. Shaw, consultant to leading British industries, will discuss "Industrial Engineering: U. S. A. and England" at the Thursday evening banquet.

Leading experts from industry, labor, and education will discuss the latest trends in methods, time study, motion economy, materials handling, production control, incentives, and plant layout.

The clinic will feature the winning films of the Society's Methods Improvement Competition which has been conducted throughout industry during the past year.

More than 2000 works managers, production executives, and industrial engineers from all parts of the country are expected to attend the three-day clinic.

Instrumentation

THE School of Engineering, Louisiana Polytechnic Institute, Ruston, La., announces the fifth annual Instrumentation Conference to be held on the campus on Nov. 1–2, 1956.

An interesting program has been arranged which includes the following papers to be presented at the technical sessions:

Radioactive Density and Level Measurements, by Philip E. Ohmart, president, The Ohmart Corp., Cincinnati, Ohio

Organization of Instrument Departments for Processing Plants, by G. C. Carroll, principal instrument engineer, Mathieson Chemical Corp., Morgantown, W. Va.

Graphic Panels and Data Reduction Instruments, Present and Future, by M. D. Shriver, general sales manager, Panellit, Inc., Skokie, Ill.

New Methods in Gas Measurement, The Foxboro Company, Foxboro, Mass.

Automatic Operation in Oil and Gas Production, by R. N. Crossman, Jr., Garrett Oil Tools, Inc., Longview, Texas

Automatic Controls on a Continuous Digester, by Pascal Law, Southern Kraft Division, International Paper Co., Camden, Ark.

Exhibits of new equipment in instrumentation and process control will be displayed by representatives of the leading manufacturers of such equipment.

Industrial Development Exposition

THE first annual National Industrial Development Exposition, to be held at the new Coliseum in New York, N. Y., November 12 to November 16, will establish a national marketplace where corporation executives, industrial realtors, engineers, and management consultants can explore the advantages offered by state and regional development organizations.

Equal exhibit space allocations have been established for the states, Puerto Rico, Hawaii, Alaska, and the Canadian provinces, in order to forestall domination of the Exposition by an individual exhibitor. Similar allocations, on a more restricted basis, will permit transportation companies, utility companies, and ports of authority to participate.

It is expected that the exposition will attract a record attendance by businessmen due to peak interest of industry in industrial expansion. United States business now plans to spend almost $39 billion for new plants and equipment in 1956, a 30 per cent increase over spending in 1955, with a high level of expenditures already planned for 1957, 1958, and 1959.

The Exposition's seminar program will feature prominent speakers from corporations with successful expansion records.

People

JOHN W. HARSCH, director of engineering of Leeds & Northrup Company, Philadelphia, Pa.; WILLIAM C. DUNN, chairman of the board, Ohio Crankshaft Company, Cleveland, Ohio; OSGOOD J. WHITTEMORE JR., research ceramic engineer, Norton Company, Worcester, Mass.; and ERNEST G. DE CORIOLIS, Fellow ASME, and for 30 years the director of research and development, Surface Combustion Corporation, Toledo, Ohio, which has made important contributions to the science of industrial heating, were recipients of the Trinks Industrial Heating Award. The Award, bestowed annually by a judges' panel of industrial heating authorities, is named after Willibald Trinks, Fellow ASME, professor emeritus of Carnegie Institute of Technology, a member of the panel, first recipient of the award, and world authority on industrial heating problems.

The following Medals and Prizes were presented at the annual general meeting of The Iron and Steel Institute at The Royal Institution, London, England, May 16, 1956: CHARLES SYKES, F.R.S., Thos. Firth and John Brown, Ltd., received the Bessemer Gold Medal for 1956, in recognition of his distinguished contribution to the study of alloy systems particularly in the field of order-disorder changes and the effect of such changes on the physical properties of alloys; HENTON MORROGH, British Cast Iron Research Association, received the Sir Robert Hadfield Medal for 1956, in recognition of his distinguished contribution to the study of the metallography of cast iron and for researches which resulted in the discovery of nodular iron and the improvement in the quality of cast iron; F. A. GRAY and S. A. BROOKS, Appleby-Frodingham Steel Company, Ltd., received a Williams Prize for 1954, for their paper on "An Investigation of Reheating Furnace Design and Performance." The Williams Prizes for 1955 were awarded to A. J. KESTERTON, The Steel Company of Wales, Ltd., for his paper on "Some Starting and Operating Experiences at Abbey Melting Shop," and to R. WILCOCK, Samuel Fox & Company, Ltd., for his paper on "The Operation of a 60-Ton Arc Furnace at Samuel Fox & Co., Ltd."; The Ablett Prizes for 1955 went to W. ERNST, Samuel Fox & Co., for his paper on "Waste Heat Recovery Related to the Generation of Electric Power," S. R. PHELPS, Guest Keen & Nettlefolds, Ltd., for his paper on "Flying Shears for Bars and Billets—Electric Requirements," and to R. STEWARTSON, Guest Keen & Nettlefolds, Ltd., for his paper on "Flying Shears for Bars and Billets—Mechanical Design Features."

Willard F. Rockwell, Fellow ASME, board chairman of Rockwell Manufacturing Company and Rockwell Spring & Axle Company, has been knighted by the Italian government in the order "Al Merito Della Repubblica." The coveted honor—usually reserved for Italian citizens—was conferred at a luncheon held in Pittsburgh, Pa., August 6, by Vice-Counsel Carlo M. Rossi-Arnaud on behalf of the President of Italy.

William Ferguson, Mem. ASME, *seated second from right,* retiring after 10 years as chairman of the Uniform Boiler and Pressure Vessel Laws Society, receives congratulations from Herbert W. Heinrich, Mem. ASME, recently elected chairman, as members of the Society's council look on. Seated, *left to right,* are: Henry E. Aldrich, Mem. ASME, American Boiler Manufacturing Association; Mr. Heinrich; Mr. Ferguson; and Marcus Abramson, Association of Casualty and Surety Companies. Standing *left to right* are: Frank X. Gilg, Mem. ASME, The Babcock and Wilcox Company; E. M. Kloeblen, Mem. ASME, Linde Air Products Company; John L. Menson, Mem. ASME, Combustion Engineering, Inc.; R. A. Locke, Affiliate ASME, Steel Boiler Institute, Inc.; Paul Diserens, Fellow ASME, Compressed Air and Gas Equipment Manufacturers; H. F. Reinhard, Linde Air Products Company. Other council members not pictured are: J. Rowland Brown, Mem. ASME, The Reliance Gauge Column Company; R. E. Ferry, Institute of Boiler and Radiator Manufacturers; C. O. Myers, Mem. ASME, National Board of Boiler and Pressure Vessel Inspectors. The Society is a nonprofit association concerned with the safe design, construction, installation, and inspection of steam boilers and pressure vessels in the United States and Canada. During the decade that Mr. Ferguson headed the Society, 20 states and Canadian provinces adopted the uniform legislation recommended by the Society while 18 states amended their laws to make them conform more closely to the Society's model bill. In addition agreements on standards and codes were established with all foreign governments having engineering departments concerned with boilers and pressure vessels.

ALBERT E. FORSTER, president and chairman of the board of Hercules Powder Company, Wilmington, Del., recipient of the 1956 Memorial Award of the Chemical Market Research Association for his contributions to market research in the chemical industry, received the award at the annual dinner meeting held in the Biltmore Hotel, New York, N. Y.

1956 recipients of the annual industrial citations of the National Management Association include: NORRIS ROY CRUMP, Hon. Mem. ASME, president, Canadian Pacific Railroad Company, Montreal, Que., Can., as "International Management Man of the Year"; GENERAL JOSEPH T. MCNARNEY, USA (ret.), president of Convair Division of General Dynamics Corporation, San Diego, Calif., as "National Management Man of the Year"; and JOHN W. COLT, managing editor of the *Kansas City* (Mo.) *Star*, as "Free Enterprise Newswriter of the Year." The awards were presented at the thirty-third NMA national conference held in St. Louis, Mo., Sept. 28–29.

E'LISE HARMON, chemist and physicist for the Aerovox Corporation, received the 1956 Society of Women Engineers Award, presented to a woman who has made significant contributions to engineering, at the annual banquet at the Statler Hotel, Detroit, Mich., where the 1956 SWE National Convention was held.

Appointment. H. N. MULLER, JR., Mem. ASME, was appointed chief engineer of Canadian Westinghouse Company, Ltd. He was formerly assistant to the vice-president, apparatus products, Westinghouse Electric Corporation.

A special exhibit commemorating the centennial of Edward Acheson, a member of ASME, was prepared early this year by the staff of the Henry Ford Museum at Dearborn, Mich. Featured for several months in this special display were facsimiles of Dr. Acheson's more important patents and personal papers, as well as examples of his work in the development of Carborundum, electric-furnace graphite, and colloidal dispersions. The special exhibit, originally scheduled for a brief period, has been held over at the museum since March because of interest shown by visitors. Howard A. Acheson, Mem. ASME, president of Acheson Industries, Inc., views a bronze bust of his father.

Honorary Degrees. CARL L. BAUSCH, Fellow ASME, was one of the six outstanding Americans honored at Syracuse University's 102nd commencement, June 4, 1956. Syracuse University conferred an honorary LLD degree upon Mr. Bausch, senior vice-president of the Bausch and Lomb Optical Company, during the commencement ceremonies. This marked the second occasion on which Mr. Bausch was paid special tribute by his Alma Mater. In 1943 he was awarded the George Arents Medal for his distinguished contributions in the field of optics.

Rensselaer Polytechnic Institute conferred four honorary degrees during its 150th commencement ceremonies, June 8. The recipients were: JOHN PLATT MYERS, chancellor of the University of the State of New York, doctor of laws; WILLIAM P. GWINN, president and chief administrative officer, United Aircraft Corporation, doctor of engineering; A. N. KHOSLA, head of the University of Roorkee, India's oldest school of engineering, doctor of engineering; and MIGUEL VILLA, consulting engineer and professor of structural engineering, University of Havana, Cuba, doctor of engineering.

New Officers. HERBERT W. HEINRICH, Mem. ASME, has been elected chairman of the Uniform Boiler and Pressure Vessel Laws Society, Inc., and assumed his new post June 1. He succeeds William Ferguson, Mem. ASME, who is retiring after serving in this office for 10 years. The Society is a nonprofit association concerned with the safe design, construction, installation, and inspection of steam boilers and pressure vessels in the United States and Canada. Established in 1915 to foster the legal adoption of the Boiler and Pressure Vessel Code of The American Society of Mechanical Engineers and to promote uniformity in the boiler and pressure vessel regulations, the organization has recently completed working arrangements with all important industrial nations on every continent to accept boilers and pressure vessels built in accordance with the ASME codes.

DONALD S. CLARK, Mem. ASME, professor of mechanical engineering, California Institute of Technology, was nominated for president of the American Society for Metals; GEORGE M. YOUNG, technical director, The Aluminum Company of Canada, for vice-president.

JAMES R. DAVIDSON has been appointed executive secretary of the Society of Plastics Engineers. Mr. Davidson, formerly sales manager of Hoosier-Cardinal Company, assumed his new duties July 1 in the national office located in Greenwich, Conn.

Editorial Items. HARTLEY W. BARCLAY, affiliate ASME, has been appointed by the board of directors of Bill Brothers Publications as publisher of *Tide*, the magazine for advertising executives, which will operate as the companion publication to *Sales Management*, the magazine for sales executives.

ERNST B. WEGLEIN has been named editor-in-chief of the Columbia Engineering Quarterly for the academic year 1956-1957, it was announced by Dr. John R. Dunning, Mem. ASME, dean of the School of Engineering at Columbia University.

Campus Data. ARTHUR E. BRYSON, JR., has been appointed associate professor of mechanical engineering in the Division of Engineering and Applied Physics at Harvard University.

WILLIAM E. MORDOFF, who worked his way through high school in Rochester, N. Y., and college at Cornell University, became professor emeritus of mechanical engineering on July 1 after 41 years on the Cornell faculty.

IRVING KAPLAN, senior scientist and head of the Reactor Division of the Nuclear-Engineering Department of Brookhaven National Laboratories, has been appointed Gordon McKay Visiting Lecturer at Harvard University for the fall term.

Education

Lexington Plan

A SYSTEM for encouraging more college graduates to enter teaching in the sciences and mathematics, known as the Lexington Plan, is being tested by the Arthur D. Little, Inc., research staff in Cambridge, and the high schools of Lexington, Newton, and Acton-Boxboro (regional) in Massachusetts. Two graduates with degrees in a specific subject will be hired jointly by the company and the school on a three-year basis. While one of the pair is teaching, the other will work in the laboratory; halfway through the school year the two will change positions. Although the men will be paid half at industrial and half at teaching rates, the differential between the two will be partially eliminated by the fact that both will be doing laboratory work during the summer vacation period. Appointees should, in fact, earn each year approximately $1000 more than a starting teacher's salary.

Fulbright Awards

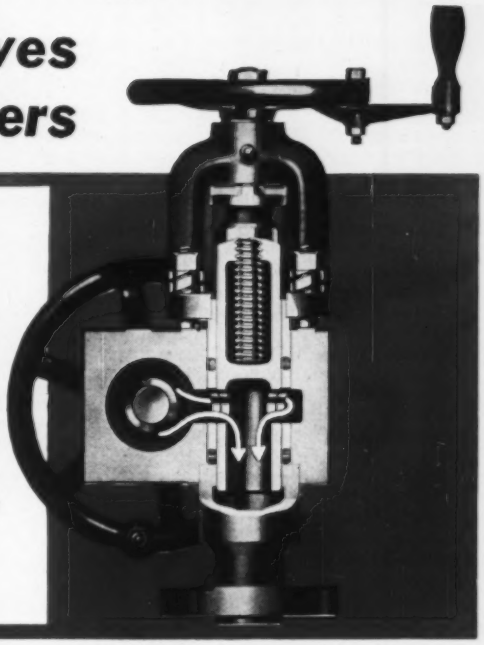
ATTENTION is called to the fact that Fulbright scholarships for graduate study abroad are open to professional persons not now engaged in college or university study. Any United States citizen with a bachelor's degree is eligible for these foreign study awards. Applicants must be at the predoctoral level and normally under the age of 35.

Nov. 1, 1956, is the deadline for submitting applications for the 1957-1958 academic year. Requests for application forms must be postmarked by October 25. Application blanks and a brochure describing the Fulbright program are available at the Institute of International Education, 1 East 67th Street, New York, N. Y., and at the Institute's regional offices in Chicago, Denver, Houston, San Francisco, and Washington. Candidates-at-large may apply directly to the Institute.

(Roundup continued on page 996)

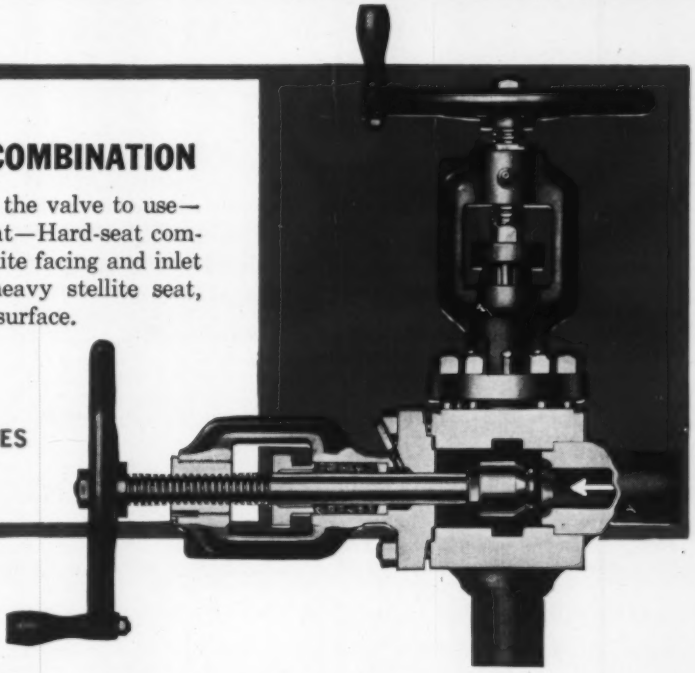
UNIT TANDEM

rugged blow-off valves for high pressure boilers



HARD-SEAT—SEATLESS COMBINATION

■ For boilers up to 1500 psi, this Yarway Unit Tandem Blow-Off Valve offers the maximum in dependable service. A one-piece forged steel block serves as the common body for the Yarway Stellite Hard-seat blowing valve and the Yarway Seatless sealing valve. All interconnecting flanges, bolts and gaskets are eliminated. The Unit Tandem at right is sectioned through Seatless Valve to show balanced sliding plunger in open position and free flow.



HARD-SEAT—HARD-SEAT COMBINATION

■ For boilers to 2500 psi, this is the valve to use—Yarway's Unit Tandem Hard-seat—Hard-seat combination. Disc has welded-in stellite facing and inlet nozzle has integral welded-in heavy stellite seat, providing smooth, hard-wearing surface.

OVER 4 OUT OF 5
HIGH PRESSURE PLANTS
USE YARWAY BLOW-OFF VALVES

Write for Yarway Catalog B-434

YARNALL-WARING COMPANY
108 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY **BLOW-OFF VALVES**

Opportunities are offered in the following countries in which the Fulbright program operates: Australia, Austria, Belgium and Luxembourg, Burma, Chile, Denmark, Finland, France, Germany, Greece, India, Italy, Japan, the Netherlands, New Zealand, Norway, the Philippines, and the United Kingdom.

Eligibility requirements for Fulbright awards are: United States citizenship; a college degree or its equivalent at the time the award is taken up; knowledge of the language of the country of application sufficient to carry on the proposed study; and good health. Preference is given to candidates not more than 35 years of age.

Fellowships

Two fellowship plans intended to provide the Armed Forces and industry with vitally needed scientific personnel were initiated today by Cornell Aeronautical Laboratory, Inc.

One annual CAL fellowship will be awarded to the outstanding ROTC student at Cornell University, Ithaca, N. Y., who has qualified for commission either in the reserve of one of the Armed Forces, or in the regular Army or Air Force. With the permission of his branch of service, the ROTC fellowship winner will pursue graduate studies at one of the University's engineering or scientific schools.

A second annual fellowship will be awarded to an outstanding engineering or scientific graduate of any college or university who qualifies for study at the Graduate School of Business and Public Administration at Cornell University.

Industrial Films

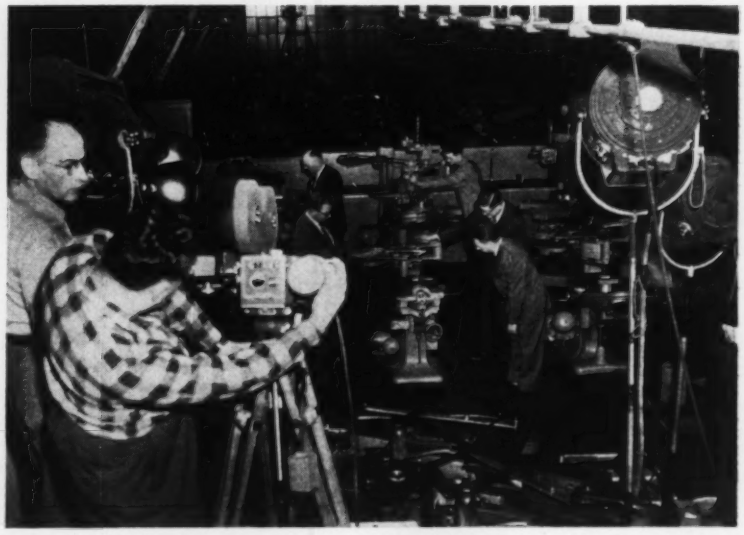
The Dalles Dam

A NEW 28½-min sound color motion picture showing progressive construction of the Corps of Engineers' newest unit in the comprehensive plan for development of the Columbia River, The Dalles Dam, 88 miles east of Portland, Ore., is now available for screening by clubs, schools, and other interested groups in the Pacific Northwest.

The film traces construction of this huge multiple-purpose project from its inception until almost the present time. Although the film was produced by the Portland District, Corps of Engineers, U. S. Army, it is obtainable on loan from the film library of the Division Engineer, North Pacific Division, Corps of Engineers, 210 Custom House, Portland 9, Ore. Information folders on The Dalles Dam project are available from the District Engineer, Portland District, Corps of Engineers, 628 Pittock Block, Portland 5, Ore.

Pentaerythritol

A NEW movie, "The Little Steps," which portrays the many research and production steps taken to make Hercules pentaerythritol a major material of commerce is now available from Hercules Powder Company. Recent major industry developments such as the introduction of nondusting PE by Hercules are included in the film which is a 15-min, 16-mm, sound-and-color motion picture. The film traces the development of PE from twenty years ago, when it was a laboratory curiosity, to today when a 100-million-lb production capacity has been made available by industry. The film is intended not only as a "case history" of the development of pentaerythritol, but also as an example of how chemical research in general continually investigates raw materials, processes, markets, the uses of products, and even products themselves, acting in all the areas of corporate activity. Locations for the film include the modern, almost completely automatic Hercules PE plant at Mansfield, Mass., and the company's Research Center, near Wilmington, Del.



Movie production shows demonstration department George Gorton Machine Company, Racine, Wis., where "Tracer Control in Action" was filmed

Machines in Action

"TRACER Control in Action," a 16-mm 36-min full-color film with an explanatory narrative on the sound track, dramatically portrays the versatility and freedom of machine action built into Gorton Pantographs and Duplicators. Difficult milling, profiling, and engraving operations are shown being easily performed on Gorton Tracer-Controlled Machines which are not restricted by gear-driven constant feeds nor by longitudinal and transverse lead screws.

The film was photographed under actual shop conditions and is available on free loan basis on letterhead request to George Gorton Machine Company, 1321-V Racine St., Rapine, Wis.; user pays return special-delivery postage. Three choices should be given as to dates and reservations should be made from four to six weeks in advance.

Research

Distillation and Absorption Columns

EXPERIMENTS on the effect of operating and design variables of distillation and absorption columns upon plate efficiency are now nearing completion at the Newark, Del., campus of the University of Delaware under the guidance of Jack A. Gerster, professor of chemical engineering at the University. The investigations initiated by, and under the direction of, the Research Committee of the American Institute of Chemical Engineers are being sponsored and underwritten by 33 industrial firms.

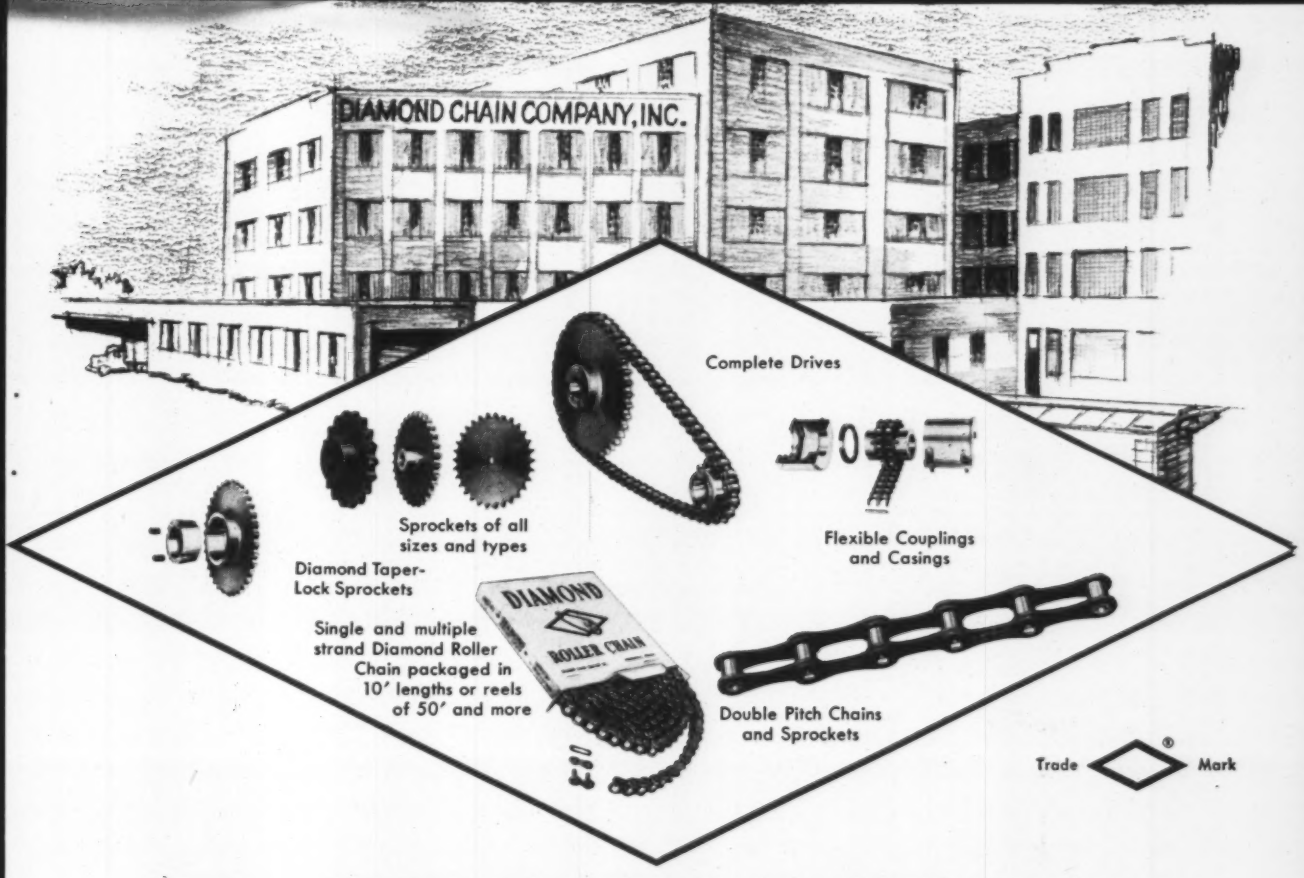
The work is being conducted through the use of a 15-ft-high experimental distillation column, which is unique because of several features incorporated into the design to insure that accurate plate-efficiency measurements can be made under commercially important conditions.

The shell and one set of tray decks for the unit were designed and constructed by the Badger Manufacturing Company, Cambridge, Mass., in close co-operation with the University staff which was responsible for devising the internals of the unit.

A column diam of 2 ft was decided upon to eliminate wall effects and thus make the results applicable to commercial units. The column contains five bubble trays which can be adjusted in increments of six in. to give tray spacings of from one to two-and-a-half ft.

Built for a working pressure of 125 psi gage, the unit also can operate under vacuum (20 in. of mercury). Special equipment allows the sampling of vapor and liquid during the

(Roundup continued on page 998)


DIAMOND CHAIN COMPANY, INC.
Complete Drives
Sprockets of all sizes and types
Diamond Taper-Lock Sprockets
Flexible Couplings and Casings
Single and multiple strand Diamond Roller Chain packaged in 10′ lengths or reels of 50′ and more
DIAMOND
ROLLER CHAIN
Double Pitch Chains and Sprockets
Trade ® Mark

YOUR DIAMOND INDUSTRIAL DISTRIBUTOR BRINGS OUR PLANT, PRODUCTS AND SERVICES

to YOUR door!

Trained in factory methods, your Diamond Distributor brings you ready knowledge on roller chain installations. He has, at his elbow, the engineering data required for almost every application.

His stocks eliminate your excessive inventory—free cash for other uses. Being a local business man his fast service and personal interest in your problems save time, save you money, make purchases easy.

Your Diamond Distributor is part of your supply team. He brings highest quality Diamond Roller Chains and Diamond *Service* to your door. Telephone today. His number is in the yellow pages of your telephone directory under the heading, Chains or Chains-Roller.

A LOCAL PHONE CALL brings your Diamond Distributor immediately—a man who knows his products—a man whose *business* is to procure for you as little or as much product as you need when you need it.

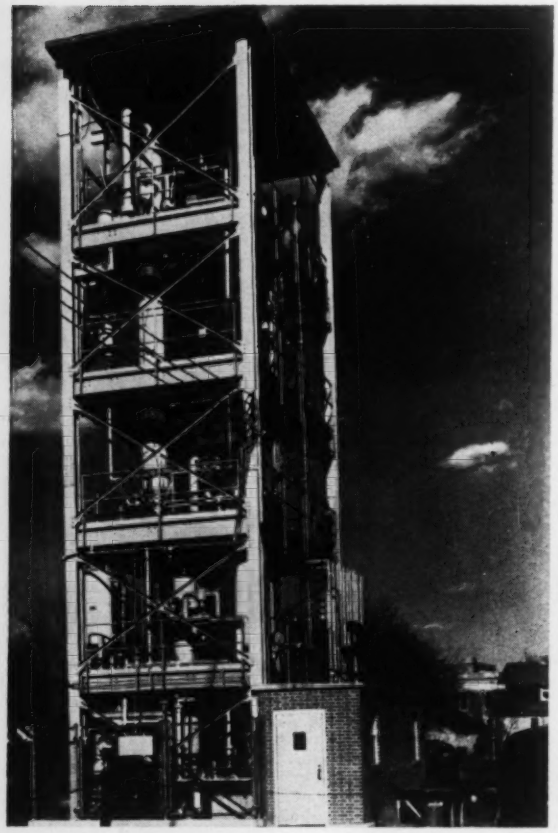
DIAMOND CHAIN COMPANY, Inc.

Where High Quality is Traditional

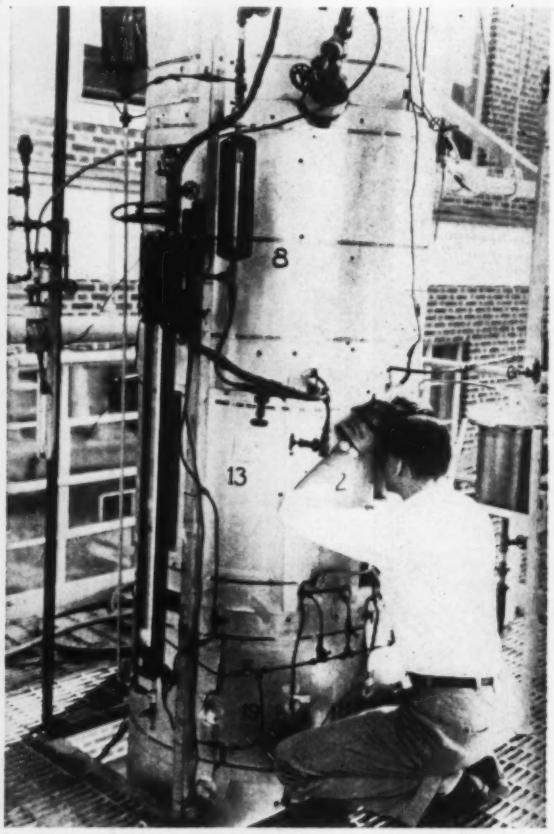
Dept. 413, 402 Kentucky Avenue, Indianapolis 7, Indiana

Offices and Distributors in All Principal Cities

DIAMOND **ROLLER CHAINS**



Distillation tower on University of Delaware campus. Experimental unit is expected to cast new light on the effect of operating and design variables of distillation and absorption columns upon plate efficiency.



Windows in the Badger-designed test column permit observation of bubble-tray action. Column is constructed to obtain accurate measurements of both plate efficiency and the variables which contribute to it.

operation and permits window-observation of bubble-tray action.

The problem of correlation and prediction of plate efficiency was chosen for study by the Research Committee of the AIChE not only because they believed this problem to be of importance to many types of chemical industries, but because the problem required substantial group effort to overcome its complexities.

Petroleum Research

Gulf Research & Development Company, Harmarville, Pa., announced that it has undertaken an expanded production-research program, to be conducted by 150 scientists, engineers, and technicians, in an effort to improve the recovery of petroleum from oil fields.

Specific aims include increasing the percentage of petroleum recovered from oil formations, and bettering both the speed and the economy of drilling wells, producing, and transporting oil and gas.

Two new buildings, to cost approximately $1\frac{1}{2}$ million, will house these activities, for which additional staff members are now being recruited. Both were begun this spring. The smaller, for heavy-drilling research, is scheduled for completion in August, 1956, and the main building in January, 1957.

The larger structure, of two-tone brick and steel frame, will be four stories high and 227 ft × 53 ft in dimensions. It will include some 94 laboratories and offices, besides storage, utility, and service rooms.

"The importance of the program in which these facilities will be used," said Blaine B. Wescott, Mem. ASME, Gulf Oil vice-president, Research, "is evident from the fact that any progress in upping petroleum recovery will increase the nation's usable oil reserves.

"While it would be foolhardy to think we will ever drain every drop from an oil field, modern research promises to bring us closer to this condition than once considered possible.

"To concentrate all resources of petroleum science toward moving nearer this goal economically is the purpose of the present undertaking."

The staffs which are tackling the assignment include scientists and engineers with degrees in chemistry and physics, and in mechanical, electrical, chemical, and petroleum engineering, plus trained technical assistance. Target for achieving full staff strength is 1958.

R. A. Morse, associate director of research, will co-ordinate the work which will be performed by the Production Engineering and the Reservoir Mechanics Divisions.

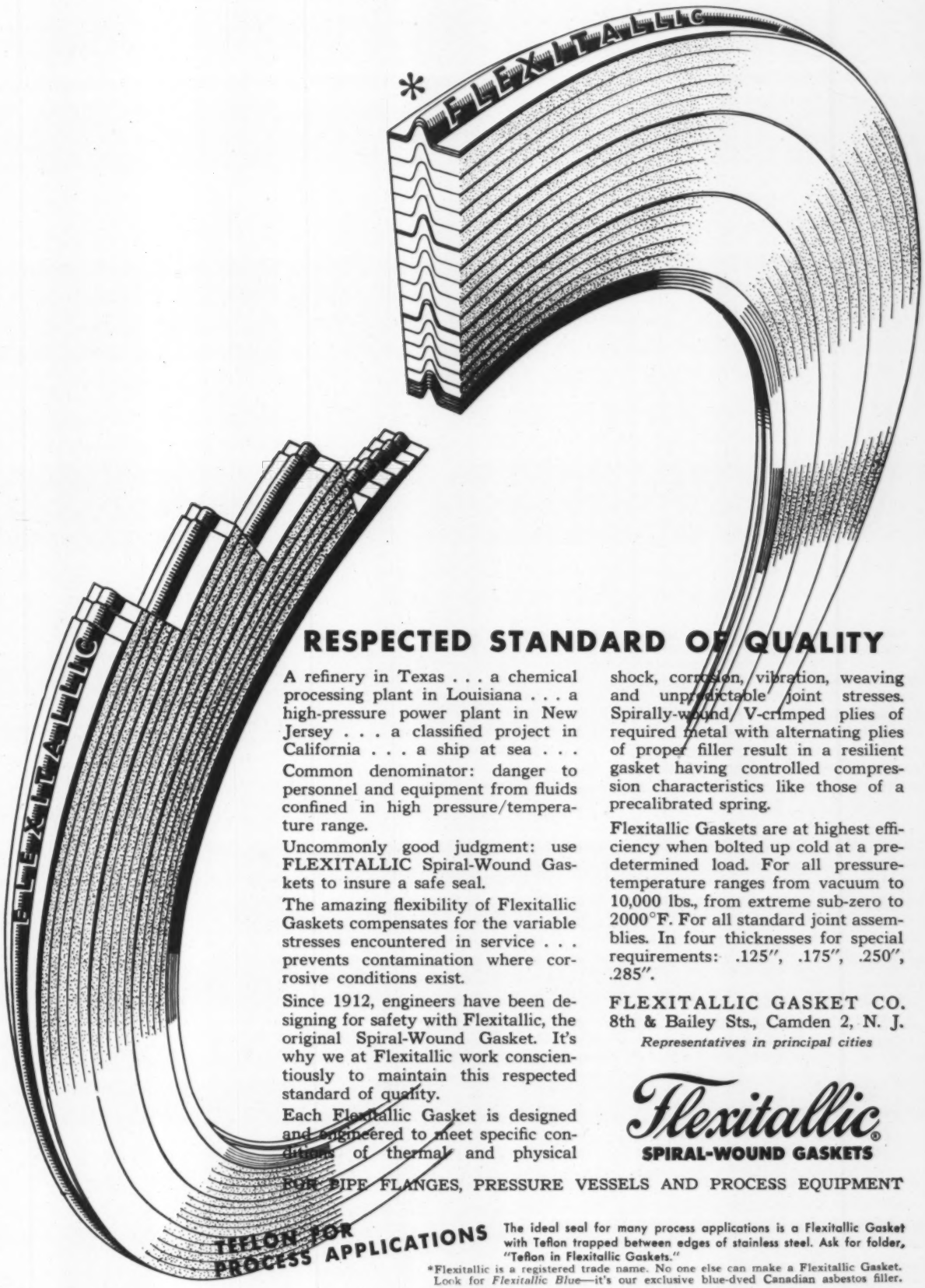
Koppers Buys Research Center Site

Purchase of a 176-acre tract of land near Monroeville, Pa., as the site for a new multimillion dollar research center has been approved by the board of directors of Koppers Company, Inc.

Koppers expects that the scope of its research program will be tripled within the next ten years. In this program, which the company plans to carry out at the new Monroeville site, the necessary research facilities will be provided to take care of Koppers' needs for many years to come.

At present, the majority of Koppers' research work is being carried on at the company's Verona, Pa., research center. There, the company has modern facilities but is limited in its expansion program because additional land is not available.

Since transferring of facilities from Verona will be gradual, there will be no interruption to a continuing program. The company states the transfer will take four years



RESPECTED STANDARD OF QUALITY

A refinery in Texas . . . a chemical processing plant in Louisiana . . . a high-pressure power plant in New Jersey . . . a classified project in California . . . a ship at sea . . .

Common denominator: danger to personnel and equipment from fluids confined in high pressure/temperature range.

Uncommonly good judgment: use FLEXITALLIC Spiral-Wound Gaskets to insure a safe seal.

The amazing flexibility of Flexitallic Gaskets compensates for the variable stresses encountered in service . . . prevents contamination where corrosive conditions exist.

Since 1912, engineers have been designing for safety with Flexitallic, the original Spiral-Wound Gasket. It's why we at Flexitallic work conscientiously to maintain this respected standard of quality.

Each Flexitallic Gasket is designed and engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally-wound, V-crimped plies of required metal with alternating plies of proper filler result in a resilient gasket having controlled compression characteristics like those of a precalibrated spring.

Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure-temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000°F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285".

FLEXITALLIC GASKET CO.
8th & Bailey Sts., Camden 2, N. J.
Representatives in principal cities

Flexitallic®
SPIRAL-WOUND GASKETS
FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

TEFLON FOR PROCESS APPLICATIONS

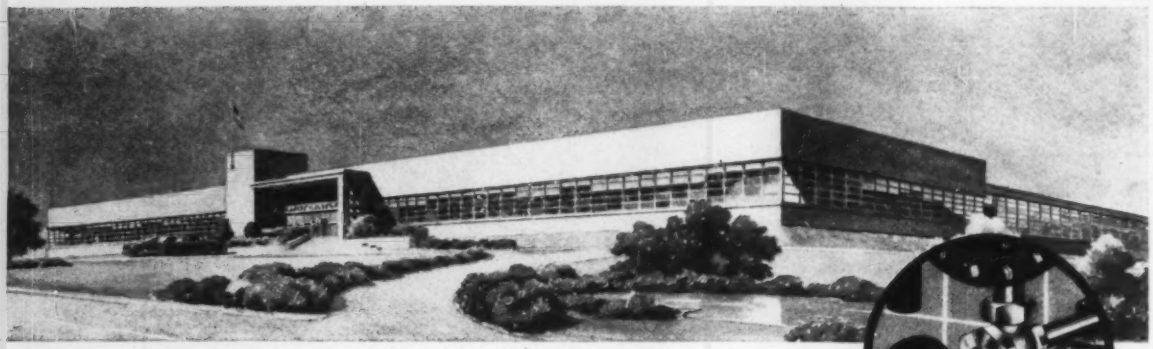
The ideal seal for many process applications is a Flexitallic Gasket with Teflon trapped between edges of stainless steel. Ask for folder, "Teflon in Flexitallic Gaskets."

*Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestos filler.

65-year test

directs choice of valves for new Rochester home of

WILMOT CASTLE COMPANY



Architect: CARL L. TRAVER *General Contractor:* JOHN B. PIKE & SON, INC.
Heating Contractor: HOWE & BASSETT CO. *Plumbing Contractor:* BAREHAM CONTRACTING CO.

JENKINS VALVES

qualify on long record of reliable performance as standard equipment on Castle Sterilizers since 1890.

The Wilmot Castle plant at Rochester, N. Y., completed in 1955, was planned with the same exacting standards applied to design of Castle's fine products — sterilizers and surgical lamps for hospitals, laboratories, and the medical and dental professions.

In selecting valves for the plant, the company could depend on their long experience with the faultless performance of the valves used on Castle Sterilizers, recognizing that all Jenkins Valves — bronze, iron, steel, and corrosion resistant — are made to the same high standards.

For *both plant and product,* the time-proved *extra value* of Jenkins Valves is dependable assurance of lasting efficiency, safety, and operating economy. Jenkins Bros., 100 Park Ave., New York 17.

THE HOSPITAL LABORATORY AUTOCLAVE illustrated is one of the many types of Castle Sterilizers used in hospitals and laboratories, and shows typical use of Jenkins Valves on the steam, water supply, and drain lines. Valves are renewable composition disc type, and have special heat-resistant, non-staining Bakelite handles, with each valve's function moulded in the top. Jenkins Valves provide the sturdy construction, safety, and good appearance required. They also permit quick, easy maintenance, since the renewable discs, made also by Jenkins Bros., are available anywhere from Jenkins Distributors.

SOLD THROUGH
PLUMBING-HEATING
AND INDUSTRIAL DISTRIBUTORS

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

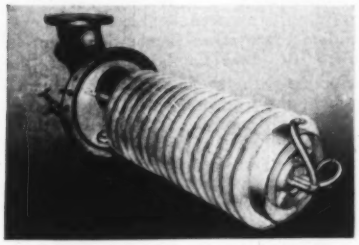
Available literature or information may be secured by writing direct to the manufacturer. Please mention MECHANICAL ENGINEERING

NEW EQUIPMENT

Instrument Tubing Support

Instrof Div. T. J. Cope, Inc., Collegeville, Pa., announces a continuous support and protection for instrument tubing. It is a standardized system that consists of expanded metal trough in various widths and lengths.

A wide range of fittings and accessories permit it to be rapidly assembled at the job site to conform to almost any installation requirement, the firm states. The company says it offers the advantages of custom design while using standardized and prefabricated sections and fittings that are available from stock.



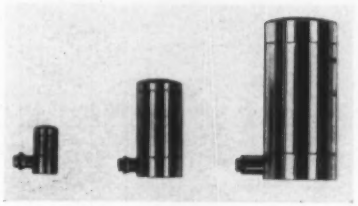
Heat Exchanger

A special heat exchanger containing 540 sq ft of heating surface but occupying only 7.2 cu ft of space has been designed and built for one of the country's largest chemical manufacturers by Schutte and Koerting Co., Dept. HT-E, Cornwells Heights, Bucks County, Pa.

The unit, when installed, will heat 3000 cu ft of vapor per min, using 450 psig steam inside the tubes.

The size of the radiafin coil bundle is 40-$^3/_4$ in. long by 19 $^3/_4$ in. in diam. Within these limits are three banks of hot-dip galvanized steel radiafin coils. Each bank of coils is separated by a rolled steel cylinder which provides a baffle and a support for the coils.

In fabricating this heat exchanger, the tubes were first finned and then formed into coils.



Vibration Measurement

Massa Laboratories, Inc., Hingham, Mass., announces standard accelerometer Models M-142B, M-191 and M-198.

They are stiffness controlled vibrating systems said to be ideally suited for making transient vibration measurements over a wide frequency range of operation.

High order harmonic components of vibrations, which may be of considerable importance in an investigation, will be revealed with this equipment, the firm states. Another important use is in making vibration measurements for noise reduction.

There is no phase shift between the applied acceleration and the generated output voltage. The units are sensitive only to the vector component of the vibration lying along the axis of the unit. The sensitivity is independent of frequency over the entire frequency range of operation. For constant velocity of vibration the accelerometer output is directly proportional to frequency, and for constant displacement the accelerometer output is proportional to the square of the frequency.

The accelerometers are essentially primary standards since their absolute characteristics may be computed from the piezoelectric and physical constants of the assemblies, which are very stable with time and temperature. They may be used as everyday working apparatus without fear of damage or change in calibration, the company says.

Steel Boilers

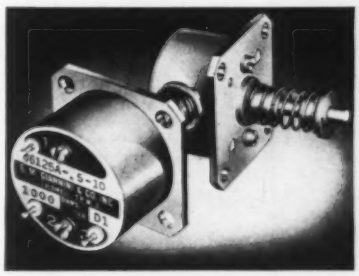
The "LoSet" line of 18 steel boilers for oil firing has been introduced by Pacific Steel Boiler Div., Johnstown, Pa., for commercial, institutional and industrial installations requiring a SBI low pressure steam rating of from 4250 to 60,710 sq ft. The SBI water rating extends from 6800 to 97,140 sq ft.

According to the maker, the zone of combustion in the boilers is moved up into the firebox. Sufficient refractory combustion chamber can be installed, says the company, so that well known makes of oil burners can operate on any grade of oil, producing good combustion, without flame impingement, and at a low noise level.

From the standpoint of stress, the firebox in the new boilers is completely separated from the shell. The maker indicates the boiler therefore is not weakened structurally by the front cutout that receives the oil burner.

The water line in the four smallest size boilers, which are produced with oval shells, is 72 in. from the floor. In the 14 larger sizes, which have round shells, the water line varies from 71$^1/_2$ to 153$^1/_2$ in. above the floor. The firm claims this low water line eliminates problems involving digging boiler pits, altering buildings to provide headroom, and constructing masonry boiler bases.

The company has available both tank and instantaneous types of domestic water heaters for use with the new boilers. It provides standard steam and water trimmings, but does not provide fuel burning equipment such as refractories, or controls.



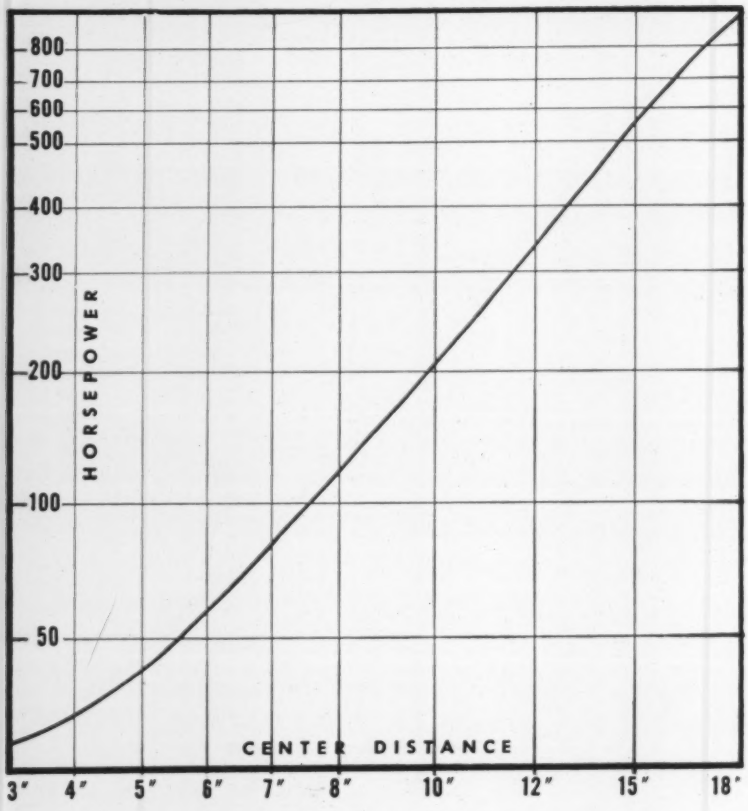
Precision Potentiometer

In 86125A pancake Rectipot, a miniature spring loaded linear motion precision potentiometer, is announced by G.M. Giannini & Co., Inc. 918 E. Green St., Pasadena 1, Calif.

Designed for applications requiring measurement of a short stroke in limited space, the unit has less than 1 in. of body length for $^1/_2$ in. stroke of the stainless steel shaft. Standard stroke ranges from 0.1 in. to 0.5 in. are offered in resistance ranges of 1000 and 2000 ohms with linearity of ±1 per cent and resolution of 0.0012 in.

Capable of long life under adverse conditions of vibration, acceleration, and temperature, the Model 86125A is designed for use in laboratory equipment, fire control systems, remote flight controls, servo follow-up on linear actuators, and industrial control systems.

"DO-IT-YOURSELF"



Prove the difference in worm gear speed reducers yourself. Here's how . . .

. . On this chart we've plotted the mechanical horsepower capacity of Cone-Drive worm gear speed reducers against their center distances. Ratings are for Class I Service with a 5:1 reduction and an input speed of 1750 rpm.

All you have to do is plot the corresponding ratings for the speed reducers you're now using or planning to use. We think you'll be surprised at the results.*

For details on Cone-Drive gearing's double-enveloping design and specifications, ask for Bulletin 600C. We'll send it to you immediately without obligation.

*If you're too busy to "Do-it-yourself", Cone-Drive representatives will be glad to show you filled-in charts.

CONE-DRIVE GEARS
DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS
Division, Michigan Tool Company
7171 E. McNichols Road • Detroit 12, Michigan

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Separator-Muffler

Heat-X, Inc., Brewster, N. Y. has introduced a line of oil separator-mufflers designated to silence system noises and separate all oil entrained with hot gas from the compressor.

The units are equipped with a mechanism that automatically returns to the crankcase all oil that is separated. The manufacturer points out that ratings of the units are based on tonnage rather than horsepower to permit close matching of unit to requirements.

The new units have no floats which can hang open or stick closed. A positive action velocity pressure mechanism opens only when compressor is running and closes of its own weight when compressor stops. Constructed to ASME specifications, the units are available in a capacity range from 1 to 75 tons F-12 and 1 to 100 tons F-22.

Vacuum Furnace

A new production vacuum furnace designed for precision casting has been developed by Vacuum Processing Equipment Div., F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.

The precision-casting furnace incorporates many features of the company's larger vacuum furnaces for refining and casting high-purity metals.

Automatic Gas Valves

Fast closing and slow opening are features of a new line of Fireye Series 81L automatic gas valves introduced by Electronics Corporation of America, Combustion Control Div., 77 Broadway, Cambridge 42, Mass.

For use with the firm's flame safeguard systems, these motor-operated valves have a powerful compression-type spring that automatically shuts off fuel in 0.8 of a second. According to the company, a special heavy-duty electric drive unit controls the rate of opening to reach 75 per cent of maximum fuel flow in six seconds.

Another feature is the availability of a position indicating switch, which performs as a safety interlock. If, prior to light-off of a burner, the valve is open as little as a fraction of an inch, the switch will not allow the light-off to take place. Instead, the electric circuit to the burner control will remain off until the valve is completely closed.

In case of flame failure or loss of electric power, or on operation of limit switches or other interlocks in the burner control circuit, reliable closing of the valves is assured by two proved principles of construction. One is the "double safeguard" release, wherein either of two independent releases will trip the valve. A new "shearing action" by the valve disk, said to literally cut through dirt or scale on the valve seat, is the second.

Approved bp Underwriters' Laboratories and Factory Mutual, the Series 81L automatic gas valves are available in sizes from one to six in. Higher capacities and lower pressure drops are achieved in each by full area port and straight-through body design.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Epoxy Resin Adhesives

Three versatile new epoxy resin adhesives that cure at room temperature and under contact pressure to a strong solid state without forming volatile by-products are now available from Adhesives and Coatings Div., Minnesota Mining & Mfg. Co., 423 Piquette Ave., Detroit 2, Mich.

The adhesives are designated as EC-1294, E3-1474, and EC-1472. All three can be used for bonding aluminum, brass, copper, steel and other metals to each other, to glass and to many plastics. They are each cured with different activators to form epoxy resin adhesives that have 100 per cent solids content.

Adhesive EC-1472 is said to be much more flexible after curing than conventional epoxy adhesives. This feature provides high strength bonds that have greater bending strength and greater resistance to cracking or shattering under shock or bend loads, the firm states.

The EC-1294 adhesive cures to a clear hard light amber colored material that has good machining properties and adhers to aluminum, steel, brass, glass and many plastics. The company says typical uses include the permanent positioning of metal and plastic sleeves, bushings and inserts. It can also be used as a permanent anchor for metal and plastic parts. By adding aluminum powder it can be used as a metallic appearing sealer for filling-in or eliminating surface cracks, joints, pinholes or gashes on ornamental, cast or machined metal.

Adhesive EC-1294 may be cured with EC 1295 or EC-1468 activators. When cured with EC-1295, it offers exceptionally high room temperature shear and bend strengths. For example, after curing for 7 days at room temperature typical shear strengths obtained from $\frac{1}{2}$-in. overlap bonds of 24ST3 Alclad aluminum at room temperature were 4100 psi.

Curing EC-1294 adhesive with EC-1468 activator is a slower process which offers additional handling advantages. Compared with EC-1294/1295 this adhesive is slightly darker in color, has superior 180 F strength properties and better resistance to water and 100 per cent humidity. Room temperature shear strengths, however, are considerably lower.

The EC-1474 adhesive is a lower cost formula having many of the properties of EC-1294. It is designed for use where cost is a major factor and high shear strengths and light color are not necessary. This adhesive

EAGLE
Microflex Reset Timer

NOW . . . quick plug-in connection!

See that new-design terminal panel? Terminals are all in a row. So you can quickly and easily adapt the Microflex Reset Timer to plug-in connection. Simply use a Microflex Plug-In Kit, available in all accepted variations. You can even rotate the terminal panel for rear connection — (just loosen two screws) — without any rewiring.

Time settings of pinpoint accuracy are possible with the Microflex double dial. Through precision vernier action, one complete turn of the *inner* dial advances the *outer* dial just one division. That's a 20-to-1 ratio, made possible by a patented Microflex threaded axle and pinion. Accuracies are obtainable to 1/60 second. Over 150 timer operating combinations, plus a wide range of long or short time periods. The ideal timer for molding presses, dielectric heating, automatic mixing, die casting machines, machine tools and rubber curing.

Write for FREE Bulletin 110.

MAIL COUPON TODAY

EAGLE SIGNAL CORPORATION
Industrial Timers Division, Dept. ME-1056
MOLINE, ILLINOIS

Please send Bulletin 110 containing complete data on Microflex Reset Timers.

NAME AND TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

WILEY — BOOKS

1) CAMS
Design, Dynamics, and Accuracy
By HAROLD A. ROTHBART, City College of New York
The first work on cams to go beyond simple drafting techniques, this unusually comprehensive book offers a thoroughly modern treatment of dynamics and machine design, using cams as a basis. Covers both theoretical and practical aspects, makes concrete recommendations, and keeps mathematics at a minimum. 1956. 350 pages. Illus. $9.50.

2) ROCKETS PROPULSION ELEMENT
An Introduction to the Engineering of Rockets
By GEORGE P. SUTTON, University of California
This second edition, revised and enlarged, includes a broader survey of the basic elements plus a fuller description of the physical mechanism, applications, and designs of rocket propulsion systems. The only technical book on this subject, its practical treatment will help everyone in the field. 1956. 483 pages. $10.25.

3) THE ANALYSIS OF STRUCTURES
Based on the Minimal Principles and the Principle of Virtual Displacements
By N. J. HOFF, Polytechnic Institute of Brooklyn
Unifies all the methods of structural engineering within a framework of basic principles. Discusses the principle of virtual displacements, minimal principles of structural theory, buckling phenomena, complementary energy, and least work methods in a clear and understandable form. 1956. 493 pages. Illus. $9.50.

4) AUTOMATIC PROCESS CONTROL FOR CHEMICAL ENGINEERS
By NORMAN H. CEAGLSKE, University of Minnesota
A basic, systematic approach to the analysis and design of control systems from the chemical engineering viewpoint. The realistic treatment results in a concise, practical, and authoritative source of background material for the operation and design of automatic systems. 1956. 228 pages. 146 illus. $6.75.

5) DESIGN OF PIPING SYSTEMS
Second Edition
By Members of the Engineering Departments of The M. W. KELLOGG COMPANY
The subject of structural design of piping systems is fully covered in this up-to-date and comprehensive book. It includes the most complete and detailed account of the thermal expansion problem ever published, an excellent discussion of pipe supports, and offers help in solving many design problems. 1956. 365 pages. 319 illus. $15.00.

6) THEORY and PRACTICE of LUBRICATION for ENGINEERS
By DUDLEY D. FULLER, Columbia University and The Franklin Institute Laboratories
Here is a complete picture of lubrication that balances theory and practice. Demonstrates practical ways to reduce wear and power loss, and includes designs for an exceptionally wide variety of bearings made of all materials from soft rubber and wood to ceramics and glass. 1956. 432 pages. 243 illus. $10.50.

7) LEGAL PROBLEMS IN ENGINEERING
By MELVIN NORD, Consultant in Law and Engineering
A thorough and authoritative work that deals with those aspects of the law which concern engineers. Used as a reference and guide, it will help avoid legal problems before they arise, and show how to work more effectively with lawyers if they do. 1956. 391 pages. $7.50.

8) PRACTICAL SOLUTION of TORSIONAL VIBRATION PROBLEMS
With Examples from Marine, Electrical, Aeronautical, and Automobile Engineering Practice. Volume I, Third Edition
By W. KER WILSON, D.Sc., Ph.D., M.Sc., Wh.Ex., M.I. Mech. E.
Includes frequency calculations and analysis of the characteristics of different types of oscillating systems, with added material on geared systems and systems containing distributed masses. Simple in treatment with many examples from current engineering practice. 1956. 704 pages. Illus. $16.00.

9) BEARING LUBRICATION ANALYSIS
By R. R. SLAYMAKER, Case Institute of Technology
Covers the general principles of lubrication analysis for full journal bearings and bearing design, and provides the insights needed to design actual bearings for simple cases and handle the preliminary planning for more complex applications. 1955. 108 pages. Illus. $5.00.

10) ELEMENTARY NUCLEAR THEORY
Second Edition
By HANS A. BETHE and PHILIP MORRISON, both of Cornell University
Fully revised to include results of recent high-energy nuclear experiments. 1956. 274 pages. Illus. $6.25.

11) BASIC MATHEMATICS FOR SCIENCE AND ENGINEERING
By PAUL G. ANDRES, HUGH J. MISER, and HAIM REINGOLD
1955. 846 pages. $6.75.

Mail this coupon for ON-APPROVAL copies!

JOHN WILEY & SONS, Inc. ME-106
440 Fourth Ave., New York 16, N. Y.
Please send me the book(s) circled to read and examine ON APPROVAL. I will return the book(s) within 10 days and owe nothing, or I will remit the purchase price(s), plus postage.

1 2 3 4 5 6 7 8 9 10 11

Name.....
Address.....
City.....Zone.....State.....

☐ SAVE POSTAGE! Check here if you ENCLOSE payment, in which case we pay postage. Same return privilege, of course.

KEEP INFORMED
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

bonds aluminum, steel, brass, and other metals to themselves and to many plastic materials.

This adhesive cures with the addition of an accelerator called EC-1475. Room temperature shear strength is 2015 psi after a 7-day cure at room temperature.

The EC-1472 adhesive can be used where good flexibility, shock and peel resistance is desired, the firm states. One unique characteristic of this adhesive is that its activator, EC-1473, is mixed with the base resin in equal parts, thus providing a simple, easily mixed adhesive compound. After a 7-day room temperature cure, the adhesive presents an excellent balance of properties. It has good room and low temperature shear strengths as well as good room temperature bend strengths. For example, tests indicate shear strengths of 3430 psi at room temperature and 2030 psi at −65 F. Because of low heat resistance, this adhesive should not be used in applications where temperatures above 120 F are encountered.

Epoxy resin adhesives may be applied by knife coating, spatula, notched trowel, or by flowing into place. Viscosity of epoxy compounds is generally affected by temperature. Most products handle well at temperatures from 75 to 90 F. Spacers should be used to insure an adhesive thickness of 2½ mils. One spacing method used in the laboratory is the placing of 4 mil glass fiber threads in the bond about 2 in. apart. The spacer threads are positioned so that they uniformly support the bond.

Centrifugal Fans

A line of Airfoil centrifugal fans for heavy duty industrial applications is available from American Blower Corp., Detroit 32, Mich.

The new units are available with single and double inlet construction in sizes for volumes up to 1,000,000 cfm.

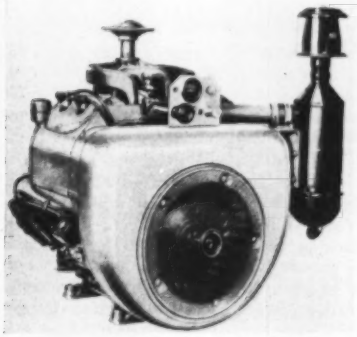
According to the company the fans feature low operating cost and operate at a mechanical efficiency of more than 92 per cent and static efficiency over 88.5 per cent.

The wheel in the new fans is of welded construction with blades of airfoil cross section, reinforced for additional strength. The hub of cast steel is riveted to the hub-plate and bored to close tolerances. The housing is of all-welded steel construction braced with stiffeners. A split section housing is designed to facilitate wheel removal for inspection or maintenance. The shaft is of forging-quality steel which is normalized and tempered before being turned and ground to close tolerance.

Anti-friction or self-aligning sleeve bearings are furnished with the new fans as specified. One fixed and one free bearing are used. They may be either water cooled or air cooled. Sleeve bearing design is such as to permit sleeve removal from the housing without disturbing the bearing support. Oil ring lubrication is standard on sleeve bearings. The fixed sleeve bearing is furnished with two internal split-type thrust

collars. Where high end thrust is anticipated, special split-bronze thrust rings are used between the ends of the sleeve and the thrust collars.

Volume control for the centrifugal fans can be achieved with an adjustable speed fluid drive, inlet vanes, outlet damper or adjustable speed a-c motor, the company says.



Air-Cooled Engine

An air-cooled engine is announced by Wisconsin Motor Corp., Milwaukee, Wis. It is designated as the Model VH4 and is 30 hp, 4-cylinder V-type engine.

The new engine is of basic high torque design, heavy-duty construction and operates at a maximum speed of 2800 rpm. It is said to be the most powerful engine of its size. The manufacturer further reports that it is an exceptionally smooth-running, even-firing engine and can be adapted to operate on kerosene, natural gas, LP fuels or fuel oil of 38–42 deg Baume gravity and 35 octane rating.

Special equipment available for the engine includes hydraulic pump, visual-type air precleaner, rotating screen, automatic high temperature switch, electric generator and starter (or starter only), clutch assembly, reduction assembly or clutch-reduction assembly. The unit will be supplied as an "open engine" with or without side-mount fuel tank or as a completely housed power unit with either built-in or underslung fuel tank.

Heavy Air Hammer

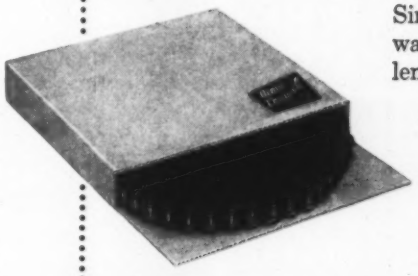
The firm's model AD 500 heavy duty air hammer has been announced by Superior Pneumatic & Mfg. Co., 4758 Warner Rd., Cleveland, Ohio.

Designed for a variety of industrial and automotive applications, the model delivers 2200 blows per min at less than 80 psi. It weighs under 4 lb and is said to be extremely maneuverable. A patented safety chuck locks the various tools used with the hammer in six different positions.

According to the manufacturer the unit can do heavy cutting, chipping, chiseling or grooving.

off the shelf service
of ACME Precision Chains
saves you time and money!

Your Acme Distributor has the chain you need
RIGHT IN STOCK – ON THE SHELF!



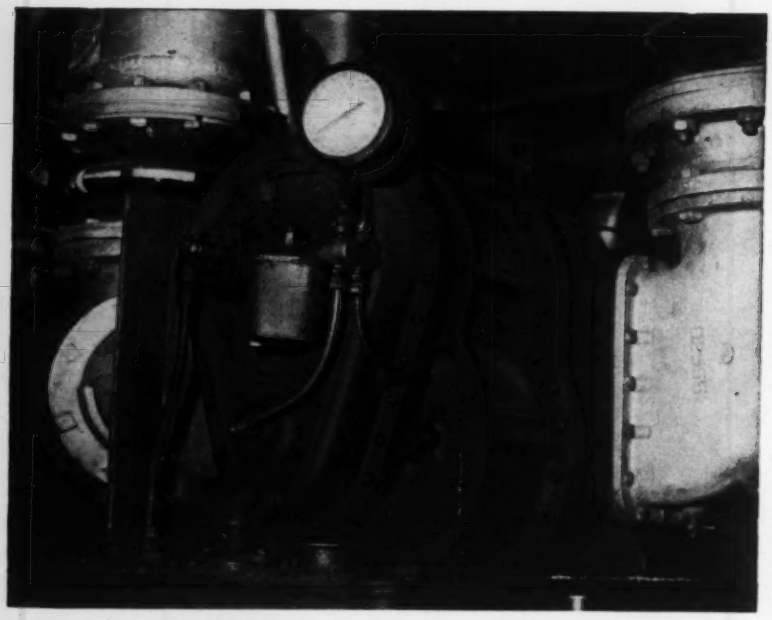
Single strand roller chain is always available in 10 and 25 foot lengths at your Acme distributor. Neatly packaged in clean convenient cartons, plainly marked for easier handling and shipping. Packaging eliminates dirt, prevents damage to chain. Available in all standard sizes. Another Acme service you'll find most useful and economical. Reels also available for handling large quantities of Acme Chain. See your Acme distributor.

FREE CHAIN CATALOG

Write Dept. 11-F for your 80-page copy of Acme's latest catalog. Packed with valuable chain data. An indispensable chain reference.

Call ACME for Service

Acme Chain Corporation
HOLYOKE
MASSACHUSETTS



Operates 15 months at 165% overload—
not a sign of wear

A large eastern chemical company, requiring a continuous high volume of air, installed the 980 pound Standardaire Blower shown above to replace a 4800 pound blower of competitive manufacture.

This Standardaire model, a low pressure unit rated to operate at 1750 rpm and 4.5 psi, was forced to operate at 2200 rpm and 12 psi day and night, out of doors . . . for 15 months. During that time, it moved approximately 1⅓ billion cubic feet of air.

Disassembled to determine the effects of this gruelling run, engineers detected no discernible sign of wear. The main and gate rotors were like new. The interior was completely dry and free of oil. Axial clearance of the main rotor shaft thrust-radial bearing had increased less than 0.0005 in. Other bearings were in perfect order.

Reports such as this are not unusual. Standardaire Blowers installed throughout this country and others are performing under exceptional overload conditions for extended periods without maintenance other than lubrication. These units provide greater capacity per pound of blower with less power consumption than any other make. Write for complete information.

READ STANDARD
CORPORATION

BLOWER-STOKER DIVISION
370 LEXINGTON AVENUE, NEW YORK 17, NEW YORK

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Acid Handling System

Graver Water Conditioning Co., 216 West 14th St., New York, N. Y. is offering a method of acid handling for plants using acid in carboys and drums.

This equipment can be furnished as part of the regenerant system of water treatment processes such as demineralization, hydrogen zeolite ion exchange and acid stabilization. According to the company, it provides a safe and simple method of handling any amount of acid that must be diluted with water.

Known as the vacuum acid handling system, it enables the transfer, measurement and dilution of acid to be accomplished without the necessity of lifting carboys or drums and without subjecting any vessels to positive pressures.

Only a water line need be added to the system as furnished. The acid is drawn from the drum or carboy to the measuring tank by the vacuum created by the water operated ejector. When the proper amount of acid is in the tank, the flow is stopped by merely opening a vacuum breaker. Excess acid draws back to supply source. After the dilution tank is filled with water, the measured acid is drained into the dilution tank. The proper amount and concentration of acid is then ready for use in the regeneration system.

Displacement Pumps

A new line of submerged rotary pumps is being manufactured by Granberg Corp., 1308 67th St., Oakland 8, Calif. The pumps operate on the firm's patented universal-joint principle of rotary positive displacement design.

They are claimed by the company to eliminate priming problems completely, regardless of temperature of liquid, and are designed for use in refineries, bulk plants, barge unloading stations, and other installation where suction problems exist.

The new submerged pump is available in a complete package unit with discharge column and driving head integral with the pump. The suction assembly can be lowered into a manhole of 15 in. ID, and can be used in either shallow or deep tanks, as additional sections are available in multiples of 5-ft lengths.

The pump is driven through a vertical steel shaft within the discharge column and powered by an explosion-proof electric motor, coupled with integral gear reduction as required. If desired, pump can be powered by gasoline engine or belt-drive. The center column supporting the pump has flanges designed to facilitate disassembly for inspection or repair, without special equipment.

All shaft bearings are of the self-lubricating type and the pump is packed with suitable material for handling gasolines with special self-tightening gland. Gears and anti-friction bearings are oil-bath lubricated with oil seals that prevent leakage.

The new models are available in capacities up to 300 gpm.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Steam Trap

Production of a 140-S Hydro-Flex steam trap has been announced by Strong Steam Specialties Div., Strong, Carlisle & Hammond Co., Cleveland 13, Ohio. According to the company, distinctive feature of this moderately-priced trap is a built-in stainless strainer which prevents clogging and reduces cleaning maintenance time.

Other features listed by the firm are small size and weight, bucket action for efficient operation under all load conditions, durable semi-steel body and all stainless steel working parts.

The strainer is located on the inlet side to catch foreign matter before it has a chance to clog the trap. The company says the strainer screen is installed in a vertical position and may be easily and quickly removed for cleaning.

The trap is being sold to manufacturers of new equipment for the laundry and dry cleaning industry, canning and packaging plants, dairies and for use on sterilizing equipment, package boilers, and tracer lines, the company states. The traps are suitable for working pressures up to 150 psig. Inlet and outlet tapped hole sizes are $^1/_2$ and $^3/_4$ in.

Electric Fan Motor

A new permanent-split-capacitor fan motor designed for smaller, more compact room and console air conditioners has been developed by General Electric Company's General Purpose Motor Dept., Schenectady 5, N. Y.

Nearly 25 per cent shorter than previous models, the new motor is available in ratings from 35 mph to $^1/_6$ hp. The fan motor is designed to help simplify application problems of air conditioner manufacturers.

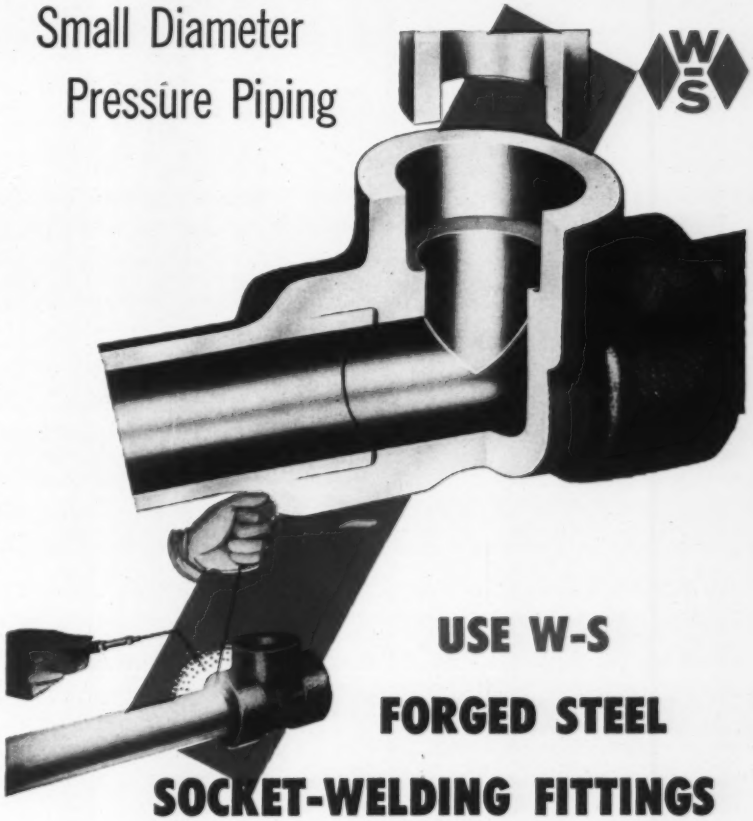
Built-in lubrication of the new unit provides five years of lubrication under normal motor operation, the firm says. With average summer-only use, this motor requires no relubrication, according to the company.

Speed versatility of this Type KCP, permanent-split-capacitor motor is said to afford ease of standardization and adaptability. High efficiency of the unit is claimed to result in lower operating temperatures that extend lubrication and insulation life. A terminal board, equipped with quick-connect terminals and mounted on the stator shell, is a standard feature.

The stator and shell assembly are dipped in protective varnish to afford protection against climatic conditions. Motor end shields are constructed of aluminum and the motor's enclosed shell construction helps keep dust, condensate, and foreign matter out of the unit.

Capable of delivering a 100 w output, the unit is 4.25 in. long and 5–6 in. in diam. Higher outputs in longer lengths are available. The motor operates from 1040 rpm to 1150 rpm.

Here's the **EASY WAY TO WELD**
Small Diameter
Pressure Piping



USE W-S
FORGED STEEL
SOCKET-WELDING FITTINGS

In addition to providing high strength and toughness, W-S Forged Steel Socket-Welding Fittings are also easy to install. Deep sockets support and align the pipe for welding . . . eliminating the need for tack welding or special fixtures. No back-up ring is needed either. The fillet-weld is completely outside the pipe. Welding icicles just can't form inside the pipe. The result is a clean, tight welded joint that will readily resist high pressures and the stresses of shock and vibration. What's more, installation costs are lower.

W-S Socket-Welding Fittings are available in sizes ⅛" to 4" for schedule 40, 80, 160 and double-extra heavy pipe in carbon steel, stainless steels and alloy steels.

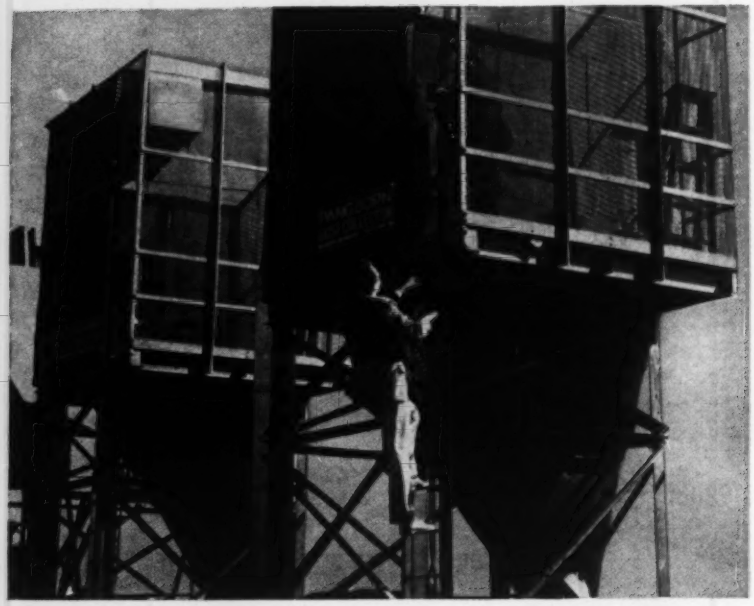
For complete information on the installation and operation advantages of W-S Forged Steel Socket-Welding Fittings, send today for Bulletin A-3-56.

W-S FITTINGS DIVISION
H. K. PORTER COMPANY, INC.
Roselle, New Jersey

General Tire & Rubber elects

Pangborn Dust Control for its plant

... and polls a saving of $75,000 a year!



General Tire and Rubber Co., Akron, Ohio, was losing hundreds of pounds of carbon black every day. To control this valuable ingredient in the manufacturing process, General Tire & Rubber installed five Pangborn Dust Collectors and gained three primary benefits. The firm maintains quality control in the manufacturing process by keeping ingredient quantities exact. In the winter the already-heated air can be returned to the plant and re-used after cleaning, resulting in high fuel savings. And finally—a tremendous cost advantage—Pangborn Dust Control permits salvage savings of approximately $75,000 a year!

Pangborn CONTROLS DUST

How do you Vote?

If you're interested in efficient, profitable plant operation, cast this "ballot" for additional information on Pangborn Dust Control. Send to Pangborn Corp., 2200 Pangborn Blvd., Hagerstown, Md.

CAST YOUR BALLOT

☐ Please send me more information on Pangborn Dust Control immediately.

Name_____

Company_____

Address_____

City_____ Zone_____ State_____

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Test Equipment Calibrator

A new, low-cost, laboratory-type test equipment calibrator said to be accurate to 1 per cent or better in all of its voltage sections is now offered by B&K Mfg. Co., 3731 N. Southport Ave., Chicago 13, Ill.

According to the company, the Model 750 calibrator quickly checks test equipment accuracy, reveals how far any instrument may be off and helps make necessary adjustments. It is designed to prevent errors in receiver servicing or laboratory and industrial calibration.

The unit calibrates VOM, VTVM and other meters, signal generators, sweep and marker generators and oscilloscopes, the company states.

It supplies 2, 5, 25, 100, and 300 v d-c, and 5, 25, 100, and 300 v a-c to check voltage ranges; provides 10, 100, 1000, 10,000 and 100,000 ohms and 10 megohms to check resistance ranges; supplies crystal oscillator capable of generating harmonic frequencies well over 300 mc, with accuracy of $^1/_{10}$th of 1 per cent.

Plugging in the proper crystal facilitates use as a marker generator in radio and television receivers, helps to check the calibration on AM signal generators, or check and align the audio IF system of TV receivers, the company says.

The crystal oscillator and pentode amplifier of the calibrator can be converted into an audio oscillator to signal-trace trouble in the audio amplifiers in AF, FM, and TV receivers, and high fidelity equipment. The unit also serves as a voltage calibrator for oscilloscopes in the measurement of peak-to-peak voltages of any unknown wave-forms such as are found in TV receivers.

Ultrasonic Cleaner

A new ultrasonic cleaning apparatus Model AP-10-B, the latest in the firm's Sonogen series of similar units, has been developed by Branson Ultrasonic Corp., 37 Brown House Rd., Stamford, Conn.

The unit is a small, compact instrument, designed specifically for bench-top operation in the washing of delicate, intricate parts that must be "surgically" clean, such as watch mechanisms, instrument components, small and miniature ball-bearings and electronic parts.

The new instrument comprises a 36–40 kc power generator, and a cylindrical cleaning tank, with transducers hermetically sealed into the base. RF power output of the generator is 50 w average, 200 w peak on pulses. Tanks are of 1-pt, 1-qt, or $^1/_2$-gal capacity, giving a maximum effective cleaning area of 18 sq in. Two of the smaller tanks may be operated simultaneously, and two of the larger tanks alternately, depending on tank size specified.

Cleaning is effected by ultrasonic activation of the solvent.

Continued on Page 50

FUTURES UNLIMITED!

...at Chemstrand

Engineers with their eyes on the future can readily see the ground floor possibilities of expanding their own careers in such a rapidly expanding new industry. (Chemstrand has expanded five times in five years of operation – with the biggest expansion yet to come.)

CHEMSTRAND

THE CHEMSTRAND CORPORATION, DECATUR, ALABAMA

WRITE TODAY

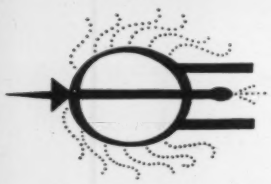
TECHNICAL PERSONNEL MANAGER, Dept. ME-10
The Chemstrand Corporation
Decatur, Alabama

Gentlemen:
It is my understanding that you need for immediate employment graduate engineers in various fields, particularly chemical, mechanical, industrial, textile and instrument engineering.
I am a graduate _____ engineer.
Please send me information concerning the ground floor opportunities at Chemstrand.

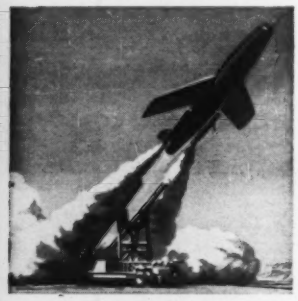
Name _____
Street _____
City _____ Zone ____ State ____

TOMORROW'S BIG DECISIONS WILL BE MADE **by the men who act today . . .**

MECHANICAL ENGINEERS



Stimulation, status, security . . . the absorbing challenge of the rocket propulsion field, the rewards of professional recognition, the stability of a firmly established organization . . . are yours at Aerojet-General.



Aerojet offers experienced mechanical engineers and recent graduates unparalleled career opportunities on a variety of important problems.

Design and development of pumps, valves, control and propellant systems for huge new liquid-propellant rocket engines.

Design and testing of a variety of thrust chambers, turbines, injection systems, and servomechanisms.

Studies of ignition, combustion phenomena, heat transfer, cooling, vibration and thermal shock.

Design and development of thrust reversers for jet engines.

Design and testing of underwater jet engines and other devices.

Design of test equipment and production machinery.

Aerojet-General CORPORATION
A Subsidiary of The General Tire & Rubber Company
AZUSA, CALIFORNIA
SACRAMENTO, CALIFORNIA

Write: Director of Scientific and Engineering Personnel, Box 296BB, Azusa, Calif. or Box 1947BB, Sacramento, Calif.

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Nylon Lubricant

Development of what is described as a superior, new lubricant for nylon, engineered specifically to provide a dry seal against oxidization and contamination of bearing surfaces, has been announced by Synco Co., United Artists Bldg., Detroit 16, Mich.

According to the firm, the new lubricant's exclusive properties result from its content of multiple lubricizing additives and corrosion inhibitors, in a solid base. Designated "Nylube," it is said to have proved remarkably efficient in actual, on-the-job tests, in providing longer, quieter, smoother operation, reduced maintenance costs, elimination of warping, dirt, rust, lint, and corrosion.

Nylube is a dry base lubricant that utilizes the principle of regelation, becoming wet and slippery as pressure is applied, then resolidifying instantly as pressure is relieved. Thus, the firm explains, it lubricates without becoming gooey, greasy, runny, or messy.

Literally microscopic quantities of the lubricant are all that is required for most efficient operation—parts are dipped or sprayed with a very light film. The average reapplication is every six months, the firm reports.

Belt Conveyor Scale

A packaged unit with integral belt conveyor and drive assembly has been announced by Weighing & Control Components, Inc., Box 245, Hatboro, Pa.

It utilizes the firm's pneumatic weight transducer and Uni-Force flexure platform designed to provide accuracy despite load placement or pile-up.

Control functions available include indicating, recording, controlling, integrating, proportioning, and programming. Performance specifications feature 1 part in 2000 repeatability and 1 part in 5000 sensitivity.

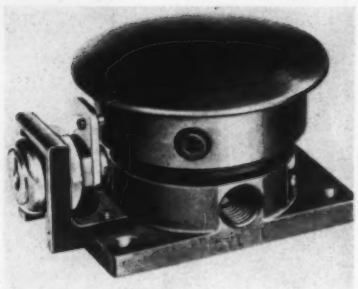
The firm states the unit is unaffected by side thrust forces and springs, knife edges, and beams are eliminated.

Induction Motors

Elliott Co., Crocker-Wheeler Div., Jeannette, Pa., has redesigned its line of integral horsepower induction motors in NEMA frames up to 30 hp. The new "Type N" motors are smaller, lighter, and more compact than former designs, incorporating more horsepower in less space, the company announces. The conventional open motor is superseded by a dripproof-protected design, said to be also essentially splashproof. The new totally-enclosed fan-cooled design is a refinement of the firm's ribbed frame motor.

The standard bearing is an open greaseable design which is, in effect, enclosed in grease to eliminate corrosion from internal or external moisture. If preferred, prelubricated cartridge-type bearings may be specified.

Bulletin PB 6000-6 describes and illustrates design features of the line.



Palm Button Valve

A leak-proof palm button valve suitable for general applications which require a normally closed straightway or three-way hand operated pilot valve is announced by Ross Operating Valve Co.,Detroit, Mich. It was designed specifically for use in circuits where safety is of prime importance.

This valve can be provided with a tumbler type lock, enabling the valve to be locked by authorized personnel in either the open or closed position.

Due to its low operating force and large diameter palm button, the 122-Series valve will reduce operator fatigue, the firm states. It is $\frac{1}{4}$ NPT side ported, and its overall height is $2\frac{3}{8}$ in. The 3-way model has a nonpiped exhaust and both straightway 3-way have a $\frac{1}{4}$-in. diam flow capacity.

High-Vacuum Pump

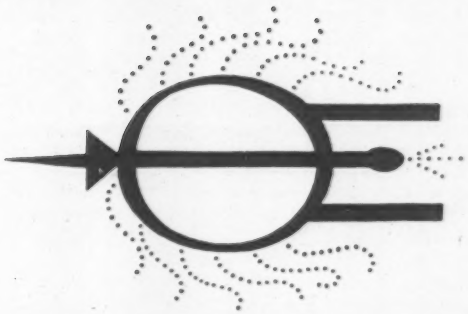
A high-vacuum pump-and-port assembly is now available from the Rochester Div. of Consolidated Electrodynamics Corp., 1775 Mt. Read Blvd., Rochester 3, N. Y.

The new stainless-steel unit, known as Type 3116-03, is expected to find wide use in evacuation of cathode-ray tubes, and the firm's engineers say it will prove particularly useful for stationary and inline evacuation systems for both black-and-white and color tv tubes. It has a pumping speed of 5 liters per second at the port opening and attains an ultimate pressure of 2×10^{-6} mm Hg.

The port accommodates either $\frac{3}{8}$ or $\frac{1}{2}$-in. tubulations, and is water-cooled to protect the sealing gasket during oven bake-out. Since the port is connected at a right-angle to the pump, broken glass cannot enter the pump jet area, the company says. A trap is provided at the base of the port for easy cleaning.

According to the manufacturer, an important feature of the pump-and-port assembly is the rapid two-minute cool-down of the pump fluid effected by internal boiler quench coils. The small boiler requires a minimum of pump fluid and is heated by a cartridge-type heater for maximum heat transfer, the firm states.

Continued on Page 52



صفة بيضة تخرج وتحرق

er-Rammah's self-moving egg

Join two flat pans; fill with an incendiary mixture; add a tail; propel by two large rockets. In A.D. 1280, Arabia's Hassan er-Rammah, gazing centuries ahead, proposed this ovoid in his "The Book of Fighting on Horseback and with War Engines."

Today, rocket-powered ordnance is foremost in American defense...and Aerojet-General Corporation is foremost in rocket power. Aerojet's solid-propellant rockets are used on the Sparrow and Regulus and on the newest, most advanced American missiles.

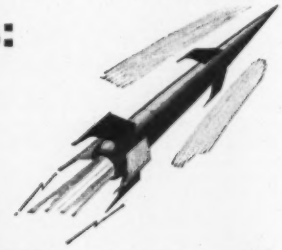
Aerojet-General CORPORATION

A Subsidiary of The General Tire & Rubber Company

AZUSA, CALIFORNIA
SACRAMENTO, CALIFORNIA

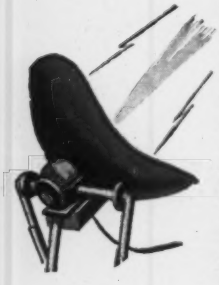
We invite you—the engineer, the scientist—to participate at Aerojet in the creation of tomorrow's realities from yesterday's dreams.

ENGINEERS: *Electronic & Mechanical*
Physicists:



Work where PERFORMANCE pays off

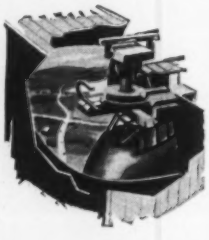
Men of talent and drive can move ahead without delay or red tape at Melpar because skill, ability and performance are the *primary* factors governing advancement. Due to the fact that we've doubled in size every 18 months since our beginnings in 1945, middle and top level positions open up constantly.



Melpar believes that the engineer deserves an organization and facilities that can enhance his creative abilities. For this reason our laboratories were designed and built to specifications prepared by Melpar engineers. A wealth of equipment is available. Our project group system enables the engineer to participate in all phases of development problems and thus quickly acquire greater technical and administrative know-how, essential to eventual managerial responsibility. The system also enables us to more accurately evaluate the individual's contribution and more rapidly justify promotions.

Live Where You LIKE It

Living—for the whole family—is immensely rich in the two locales where Melpar's R & D activities are centered. Our 265,000 sq. ft. main laboratory near Washington, D. C., enables you to live in an area enjoying incomparable cultural and recreational advantages. The climate allows outdoor recreation 215 days of the year. Fine homes and apartments are available in all price ranges. Our Watertown and Boston, Mass. laboratories offer the unique advantages of cosmopolitan Boston with its theatres, concerts, art galleries, museums, universities and schools which are second to none. Nearby are seaside and mountain resorts offering a variety of winter and summer sports.



Openings Exist in These Fields:

Flight Simulators • Radar and Countermeasures • Network Theory • Systems Evaluation • Microwave Techniques • Analog & Digital Computers • Magnetic Tape Handling • UHF, VHF, or SHF Receivers • Packaging Electronic Equipment • Pulse Circuitry • Microwave Filters • Servomechanisms • Subminiaturization • Electro-Mechanical Design • Small Mechanisms • Quality Control & Test Engineering

Write for complete information. Qualified candidates will be invited to visit Melpar at Company expense.

Write: Technical Personnel Representative

MELPAR, *Inc.*

A Subsidiary of Westinghouse Air Brake Company

3193 Arlington Blvd., Falls Church, Va.

10 miles from Washington D. C.

Openings also available at our laboratories in Watertown and Boston, Mass.

KEEP INFORMED — NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Lubrication System

Two oil-mist lubricators designed to provide a 48-hour week of continuous lubrication for up to 300 or 500 bearing inches of lubricated mechanisms while consuming but $^1/_{10}$th as much oil as by any other method of lubrication have been announced by Alemite Div., Stewart-Warner Corp., 1826 Diverse Pkwy., Chicago 14, Ill.

The lubricators operate efficiently whether in a compact installation or extended over a distance of 400 ft with automatic control of all operating conditions, the firm claims. Built-in safety switches respond instantly for maximum machine life.

The systems use compressed air to atomize oil into mist which is then distributed through tubing to all types of such mechanisms as anti-friction bearings, plain bearings, gears, slides, ways, chains, cams and rollers.

The system is operated automatically from the machine's on-off switch, has no moving parts and only requires filling of the oil reservoir. A constant, uniform volume of fresh oil film is picked up by each bearing as it needs it, when it needs it, the company states.

Dynel Battery Material

A battery separator material called Dynel-Mat has been announced by Felters Co., 210 South St., Boston, Mass. It consists of a nonwoven fabric made with dynel staple fiber.

The material was developed for the nickel-cadmium, alkaline type battery because it has exceptionally high resistance to concentrated caustic solutions, the company says. It is claimed to have excellent dimensional stability, and show low electrical resistance.

As a replacement for less chemically resistant separators when immersed in potassium hydroxide, the material is said to provide durable plate separation during the prolonged life of the new type battery. Its nonwoven structure permits effective screening action with minimum interference to internal current flow, the firm states.

For a nonwoven sheet fabric dynel can have either very low or very high tensile strength, the company points out. This depends primarily upon thickness and denier of the staple being used to produce the sheet material. The tensile strength also varies to a large extent on the method of binding that is used.

It is available with great variation of surface smoothness. It can be soft, or hard, coarse or fine, or with high or low density. It is available in roll or sheet form and rolls can be furnished up to 72 in. in width and 45 yds long.

According to the company, the material is also chemically resistant to sulfuric acid as used in the lead-acid type battery.

It is in the pilot plant stage, and sample quantities can be made up on request to the company.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Heat-Treating Furnace

A facility for vacuum or controlled atmosphere heat-treating is announced by NRC Equipment Corp. of Newton Highlands, Mass., a subsidiary of National Research Corp. (The Model 2936 vacuum heat-treating furnace has a resistance heated uniform hot zone 36 in. in diam and 36 in. high. The maximum working temperature is 2000 F and minimum pressure 0.5 mu.

Use of the unit makes possible bright surfaces, assures reproducible results, prevents adverse changes in surface chemistry, and removes surface contaminants, the company claims. It can be employed to restore the ductility of hydrogen-embrittled titanium and zirconium. The unit, introduced primarily for vacuum annealing titanium, is said to be useful for sintering, brazing, hardening and degassing. According to the company, the vertical arrangement of heating element and vacuum bell makes it well suited for production operations where product handling is mechanized.

Synthetic Rubber

The B. F. Goodrich Company, Akron, Ohio, announces that there is evidence that Ameripol SN—a synthetic rubber said to duplicate tree rubber—is equal, and in some cases superior, to crude rubber as a barrier to chemical corrosion.

Complete replacement of crude rubber by the new material for the handling of corrosive chemicals is definitely possible according to results of extensive chemical resistance tests conducted by the company, it is stated.

The company says the tests revealed that reaction of Ameripol SN to concentrated hydrochloric acid is the same as crude rubber. In both cases, the rubbers form a hard, continuous surface film, considered the key to the successful performance of crude rubber linings in contact with hydrochloric acid.

Chemical resistance tests run on pure gum compounds, including some chemicals for which pure gum is not recommended, showed that Ameripol SN may be used as a replacement for crude rubber. The firm says the tests indicated that the new material may prove superior to crude rubber in some types of this service.

The firm's conclusions are said to be based on comparative tests run on metal covered samples of Ameripol SN and crude rubber linings, and immersion tests conducted in accordance with methods prescribed by ASTM.

Chemicals used in the tests included many acids and other corrosive liquids for which rubber linings have been found advantageous for commercial use.

Ameripol SN is already being used in large truck tires, according to the company. The rubber firm recently stated that the new man-made rubber processed similarly to crude rubber during manufacture and is now giving satisfactory service in fleet operation.

Engineering News from Bridgeport Thermostat

FOR AIRCRAFT

FOR INSTRUMENTATION

FOR MINIATURIZATION

MINIATURE BELLOWS FOR INSTRUMENTS and AIRCRAFT

Save space and weight in instrument and aircraft design. Specify small-diameter seamless metal bellows. Bridgeport Thermostat's specialized experience in bellows engineering provides these tiny units as small as ¼" and 5/16" diameter, and in a wide range of characteristics and metals.

BELLOWS ASSEMBLIES

Practical savings in time, trouble and money can be made by buying complete bellows assemblies . . . let Bridgeport Thermostat show you how.

Robertshaw-Fulton
CONTROLS COMPANY

BRIDGEPORT THERMOSTAT DIVISION • MILFORD, CONN.

Send me the Bridgeport bellows data checked below: (Dept. TK-125)

☐ Full details on new, small-diameter bellows

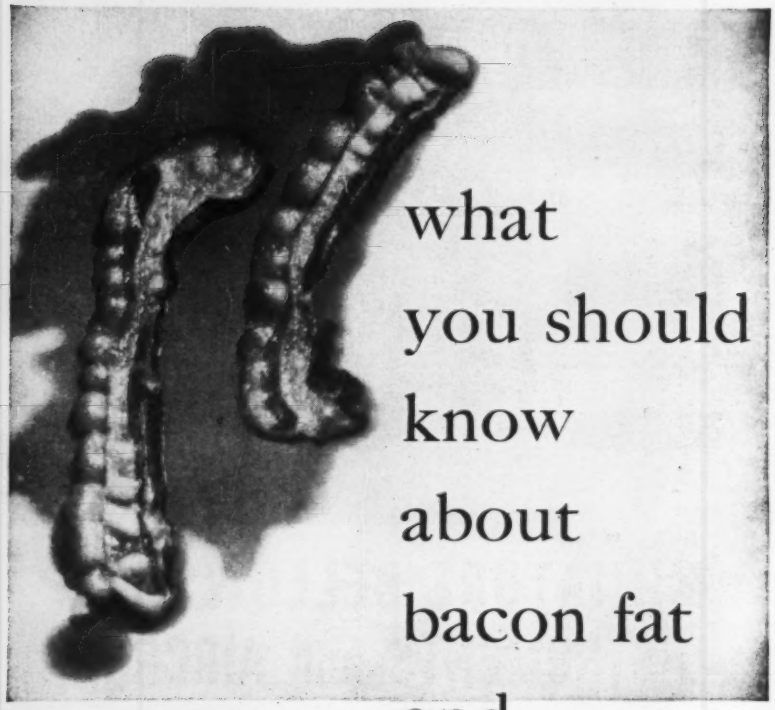
☐ Bellows Engineering Catalog

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____



what you should know about bacon fat and Albanene®

Here's the buying information you should have to get the *best* value when you buy tracing paper.

1. **The usual way** of "transparentizing" tracing papers is with waxes or mineral oils—much the way bacon fat makes a paper towel transparent. Eventually, these oily fluids "leak" out—leaving the paper opaque and useless for reproductions.

   Result: Valuable drawings on ordinary tracing papers eventually become yellow or brittle—lose their reproduction qualities. And, these days, replacements often cost twice as much as the originals.

2. **The K & E way**—Albanene tracing paper is made transparent with an inert synthetic resin which is chemically stable . . . can't leak out—ever!

   Result: Albanene stays transparent . . . stays strong . . . protects every nickel you invest in time and talent working on it.

   Important: During manufacture, constant testing *guarantees* uniformity as well as pencil taking and erasing qualities. The very qualities that have made Albanene—America's best selling tracing paper.

Try Albanene Today . . . it's available in 3 weights and in rolls, sheets or pads. Try it now . . . it's the best value you can buy!

89 YEARS OF LEADERSHIP

In equipment and materials for drafting, surveying, reproduction and optical tooling . . . in slide rules and measuring tapes.

KEUFFEL & ESSER CO.

NEW YORK • HOBOKEN, N. J. • Detroit • Chicago • St. Louis • Dallas • San Francisco • Los Angeles
Seattle • Montreal

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Drop Forging Hammer

A new piston-lift gravity drop forging hammer, claimed to permit more blows per minute and more precise stroke control than ever before achieved, is being introduced by Erie Foundry Co. Erie, Pa.

Called the Rigidrop, the new all-steel air operated hammer is said to give its operator complete control of stroke variation, allowing him to select from the full range of strokes between the conventional short and long, merely by varying pressure on the hammer's treadle.

A new guiding arrangement provides 40 per cent more guiding surface on the ram. Guide ram adjustments are made from the front and back of the unit at close to floor level. The ram can be removed from the hammer at die level, without jacking, the firm states.

Solenoid Pilot Valves

A line of small solenoid pilot valves capable of handling air, vacuum, oil, water and inert gases, is announced by Valvair Corp., 454 Morgan Ave., Akron 11, Ohio.

Available in both 2 and 3-way types, the new valves are designed for control of Speed King remote pilot operated valves or direct control of small cylinders and similar devices. The valves are extensively used in laboratories and on precision production equipment where accurate control and quick response are required, the manufacturer states.

Capacities range up to 23.8 cfm air and 3.8 gpm hydraulic. Valves are said to be capable of controlling over 600 cycles per min.

The solenoid enclosure is dust and moisture proof, completely sealed to prevent the entrance of splashing liquids or airborne contaminants. Normal service life is reputed to exceed 25 million cycles and solenoid coil is guaranteed against burn-out for the life of the valve. Both plunger and spring, the only moving parts, are of stainless steel. Hycar seats and O-ring seals resist oxidation and abrasive wear. Air passing around the plunger cleans and lubricates it and cools the coil.

The new valves are available with or without integral junction box. The junction box is large enough to accommodate 6-in. taped pigtail leads. Both solenoid cover and junction box cover are fitted with captive fasteners to prevent loss. Removal of solenoid cover renders valve inoperative.

Cylinder ports are tapped 1/4 in. NPT and electrical conduit connections are tapped 1/2 in. NPT. Valves can be supplied for direct pipe connection, with sub-base, or drilled for mounting on customer's manifold. Solenoid coils are supplied for 3 to 300 v d-c, 6 to 550 v a-c and 25 to 60 cycles. According to the manufacturer, maximum solenoid coil current consumption is 10 w.

Continued on page 57

Need more engineering information on products advertised in this issue?

USE THE POSTAGE-FREE CARDS . . .

If you would like further engineering information on any of the products advertised in this issue, circle the page numbers of these ads on one of the cards below . . . fill in your name and address and mail to us. Your requests will be forwarded to the advertiser. The information will come directly to you.

(Note: This service does not apply to students.)

MAIL THIS CARD ▶

after circling the page numbers and filling in your complete address.
NO POSTAGE REQUIRED

When more than one advertisement appears on a page, the following code identifies the location of the ad on page: T-top, B-bottom, L-left, R-right, IFC-inside front cover, IBC-inside back cover, OBC-outside back cover.

FIRST CLASS
PERMIT No. 1144
NEW YORK, N. Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

3c POSTAGE WILL BE PAID BY

MECHANICAL ENGINEERING
29 West 39th Street
New York 18, N.Y.

MECHANICAL ENGINEERING — OCTOBER 1956 issue

IFC	16	27	40	61	74	81B	91R	109	120	135	154	161TL
1	17	28	42	63	75	82L	92L	110	121	139	155	161BL
2	18	29	43	65	76TL	83L	92R	111	122	141	157L	162L
3	19	30	44	66	76BL	83R	93-94	112	123	143	157R	163TL
4-5	20	31	45	67	77TR	84	99	113	124	145	158TL	163TR
6-7	21	32	46	68T	77BR	85	100	114	125	146	158TR	164
8-9	22	33	47	68B	78T	86L	101	115	126	147	158B	187
10	23	34	48	69T	79	88L	103	116	127-28	148	159TL	189
11	24	35	53	70L	80TL	89R	104	117	129	149	159TR	191
12-13	25	37	54	72	80TR	90L	105	118	131	151	159B	IBC
14-15	26	39	59	73	81T	91L	107	119	133	153	160L	OBC

PLEASE SEND me more complete engineering information on the products advertised in the pages circled above.

NAME.....

TITLE.....

COMPANY.....

ADDRESS.....

CITY and STATE.....

Need more engineering information on products advertised in this issue?

USE THE POSTAGE-FREE CARDS . . .

If you would like further engineering information on any of the products advertised in this issue, circle the page numbers of these ads on one of the cards below . . . fill in your name and address and mail to us. Your requests will be forwarded to the advertiser. The information will come directly to you.

(Note: This service does not apply to students.)

MECHANICAL ENGINEERING — OCTOBER, 1956 issue

IFC	16	27	40	61	74	81B	91R	109	120	135	154	161TL
1	17	28	42	63	75	82L	92L	110	121	139	155	161BL
2	18	29	43	65	76TL	83L	92R	111	122	141	157L	162L
3	19	30	44	66	76BL	83R	93-94	112	123	143	157R	163TL
4-5	20	31	45	67	77TR	84	99	113	124	145	158TL	163TR
6-7	21	32	46	68T	77BR	85	100	114	125	146	158TR	164
8-9	22	33	47	68B	78T	86L	101	115	126	147	158B	187
10	23	34	48	69T	79	88L	103	116	127-28	148	159TL	189
11	24	35	53	70L	80TL	89R	104	117	129	149	159TR	191
12-13	25	37	54	72	80TR	90L	105	118	131	151	159B	IBC
14-15	26	39	59	73	81T	91L	107	119	133	153	160L	OBC

When more than one advertisement appears on a page, the following code identifies the location of the ad on page: T-top, B-bottom, L-left, R-right, IFC-inside front cover, IBC-inside back cover, OBC-outside back cover.

PLEASE SEND me more complete engineering information on the products advertised in the pages circled above.

NAME.....

TITLE.....

COMPANY.....

ADDRESS.....

CITY and STATE.....

FIRST CLASS
PERMIT No. 1144
NEW YORK, N.Y.

BUSINESS REPLY CARD
No postage stamp necessary if mailed in the United States

3c POSTAGE WILL BE PAID BY

MECHANICAL ENGINEERING
29 West 39th Street
New York 18, N.Y.

MAIL THIS CARD

after circling the page numbers and filling in your complete address.
NO POSTAGE REQUIRED

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Miniature Coupling

A miniature flexible coupling has been especially developed for subfractional horsepower motors and other small units by Lovejoy Flexible Coupling Co., Dept. MXN, 4801 W. Lake St., Chicago 44, Ill.

According to the company, typical subfractional motor applications include coding devices, radar equipment, film type and tape recorders, X-ray machines, actuators, laboratory test equipment and aircraft components. Others are solenoid units in dispensing machines, coin operated devices and similar equipment.

Rated at 1/20 hp at 1750 rpm, the full range is from .003 hp at 100 rpm to .103 at 3600 rpm. Dimensions are $^5/_8$ in. OD by $^3/_4$ in. overall length. Bore sizes are $^1/_8$, $^3/_{16}$, $^1/_4$ and $^5/_8$ in. Bodies are standard in die cast aluminum but can also be furnished in brass.

Spiders are one-piece spider type and are made from a Buna-N compound, said to be equal to rubber in elasticity, strength, resilience and resistance to abrasion, yet superior in resistance to oils, chemicals, heat, ozone, and aging.

The new miniature flexible coupling never requires lubrication and is otherwise maintenance-free for the normal life of the equipment, the company states. There is no wear on the metal jaws, since the load is transmitted by cushion compression.

Contour Correcting Machine

Sutton Engineering Co., First National Bank Bldg., Pittsburgh 22, Pa., has announced availability of a new contour correcting and straightening machine developed for the aluminum extrusion industry as means of correcting cross-sectional distortions of aluminum extrusions.

Designed for simple change-over to different extruded shapes, the machine employs multiple rolls of simple design, providing complete flexibility to correct cross-sectional distortions that occur in the extrusion and heat treatment of today's complex shapes, the company states.

The machine is furnished with one or more contour correcting stands, with provision for additional stands to be added, if desired. For simple shapes, a single stand can be used. For more complex shapes, two or more stands are desirable to accomplish multiple corrections in one pass.

space sets no limits

The most challenging engineering problems of our time await you at Martin-Denver—where an exceptional group of engineers is planning the grand assault on space itself.

Here you will find professional opportunities without limit—plus good living for you and your family in the healthful, colorful Colorado Rockies. For more information on both scores, we invite you to write Emmett E. Hearn, Employment Director, P.O. Box 179, Dept.M-10, Denver 1, Col.

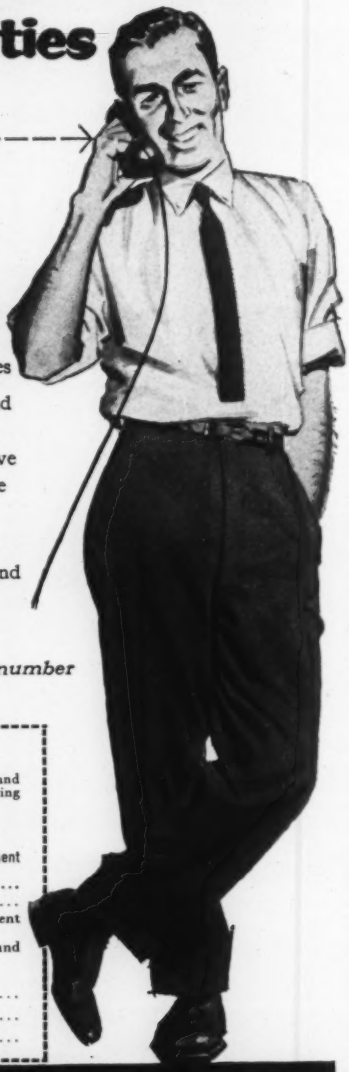
MARTIN
DENVER DIVISION

Designers

OPERATION TELEPHONE

may introduce you to

unusual advancement opportunities



Across the nation, we have talked by phone with men who have expressed interest in our design work. Easily, quickly they have been able to get the important facts on our attractive career opportunities

If *you* are restless — perhaps in a deadend job — mail the coupon *immediately*. Chances are we will call you shortly — give you an opportunity to verbally investigate what we have to offer.

Ability shows up fast in our design work. Some of our top men, with top earnings and responsibility, are comparatively young. It could happen to you.

Be sure to give us your home telephone number

Mr. E. M. Peterson, Dept. 8, Design Employment
Pratt & Whitney Aircraft, East Hartford, Conn.

I would like to learn more about your openings for product and component designers. My experience has been in the following fields:

☐ Nuclear Design ☐ Aerodynamics ☐ Bearings
☐ Compressors ☐ Hydraulics ☐ Piping
☐ Turbines ☐ Gears ☐ Controls
☐ Structures ☐ Valves ☐ Test Equipment
☐ Afterburners and Related Equipment ☐ Heat Exchangers and Combustion Problems ☐ Test Rigs

Total years Mechanical Design experience .....

You can reach me at ..... (home telephone) Most convenient hours for receiving calls are between ..... and .....

NAME .....

HOME ADDRESS .....

CITY ..... STATE .....

PRATT & WHITNEY AIRCRAFT

DIVISION OF UNITED AIRCRAFT CORPORATION, EAST HARTFORD 8, CONNECTICUT

World's foremost designer and builder of aircraft engines

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Fuel Burning Systems

Complete packaged combustion assemblies utilizing gas, oil or combination gas-oil firing for modernizing or converting existing boiler or processing equipment or for obtaining efficient operation from new boiler or processing installations now are being marketed by Orr & Sembower, Inc., Reading, Pa.

The systems include burner, automatic controls, forced-draft air supply, full modulation firing control, ignition, complete piping and wiring and the refractory required for the burner throat. According to the company, complete flexibility of the unit permits use on furnaces, ovens, vats, kilns, dryers, boilers, and numerous other types of industrial heat exchangers.

Various combinations of assemblies are available to meet installation requirements.

The new product is identical to the firing system used on the firm's Powermaster automatic packaged boilers. The burner comes as a complete unit. All components are assembled at the factory into a single fuel burning system, simplifying installation on existing or new equipment.

Five sizes are available for maximum firing rates ranging from 3-million to 25-million Btu per hr.

The air-atomizing oil conversion burner features clean, efficient combustion and modulated firing over a wide range of loads, the company states. The burner is designed to handle fuels ranging from light distillate through heavy No. 6 residual oil. Preheaters are an integral part of the heavy-oil assemblies.

Manufactured, mixed, natural, bottled, or special gas fuels can be burned in the partial-pre-mixing design gas burner. The oil/gas burner is a combination of the two, being immediately interchangeable from one fuel to the other.

Rivet Type Inserts

Rivet type threaded inserts are announced by Standard Insert Co., 12270 Montague St., Pacoima, Calif.

The company says the new inse s provide a deep, full thread when installed in sheet materials of all kinds. They are designed for insertion through sheet material, and are swaged or silver-soldered in position.

Their use for transformer and capacitor cans is particularly recommended by the company, and they may also be used for stand-offs with laminated plastic sheet material in electronic work.

The inserts are made in all regular thread sizes from No. 2 to 10. Five shank lengths are available. permitting installation in sheet materials ranging in thickness from $^{1}/_{32}$ to $^{5}/_{32}$ in.

The inserts are made in two series: tapped straight through, and blind. They are furnished as standard with Class 2 threads, and Class 3 is available to order. Brass is the standard material, and the inserts may be cadmium plated if desired.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Retractable Die Stop

A new economically priced retractable die stop has been developed and is ready for mass distribution, Keystone Engineering and Mfg. Co., 122 SW 16th St., DesMoines, Iowa, announces.

The unit is described as a time saving stop pin for compound dies. The stop is recommended by the company for stripper plates, draw rings, oil breakers and similar uses. Four body sizes are available, ranging from 1/2 to 1/4 in. in body diameter; 3/8 to 5/32 in. in plunger diameter; 1/4 to 1/8 in. retraction; 1 1/8 to 1/2 in. in body length. End pressures range from approximately 3 1/2 to 1 1/4 lb.

The body is cadmium plated and the plunger is case hardened with a black oxide finish.

Airborne Oscillograph

Explosion-proofing for airborne applications and a flash timing system for absolute synchronization of multiple oscillograph installations are now available as optional features on the standard Type 5-119 recording oscillograph made by Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

Through replacement or modification of all components subject to arcing, the new explosion-proof design has been developed in accordance with safety requirements of military aircraft specifications for hazardous locations, the company says. The explosion-proof model is for 400-cycle, 200-v, three-phase operation only.

The new flash timing system permits absolute timing through an internal or external pulse source, and is designed to synchronize timing lines from 2 to 100 remotely located oscillographs. With the flash timing system, master units can control up to ten slaves. The company states that up to one hundred units can be slaved by adding a cathode follower to the system.

Reducing, Relief Valve

A combination pressure reducing and relief valve for air, gas, oil or water service that operates on initial pressures to 4000 psi, and featuring adjustable control pressures that can vary up or down by as little as 2 psi over a range as wide as 0–2500 psi, has been announced by Atlas Valve Co., 280 South St., Newark 5, N. J.

Designated as No. 85-Type F, it is single seated, spring loaded and diaphragm actuated. The firm says it can easily be adjusted to required reducing and relief settings. Because it has no external actuating connections and is constructed without a stuffing box it requires little maintenenace, the company states.

Body construction is of stainless steel; trim is bronze and monel. It has an oil resisting Neoprene diaphragm faced with Teflon. A Bulletin, No. F-56, describing the valve, is available from the company.

Teflon*...

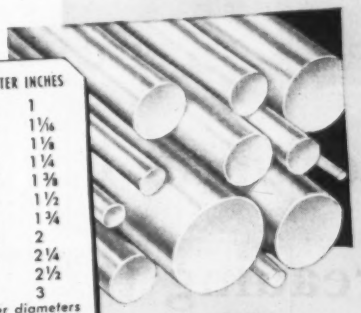
Your Best Source Is

JOHN CRANE

Thickness Inches	Nominal Size
1/16	12 x 12
3/32	18 x 18
1/8	24 x 24
3/16	36 x 36*
1/4	48 x 48*
3/8	
1/2 & Up	

* Can be furnished in 1/2 sheets

SHEET



DIAMETER INCHES	
1/4	1
5/16	1 1/16
3/8	1 1/8
7/16	1 1/4
1/2	1 3/8
9/16	1 1/2
5/8	1 3/4
3/4	2
7/8	2 1/4
	2 1/2
	3

Other diameters on specification

ROD

HERE'S WHY: You can order in quantity and in a wide variety of sizes—and be certain of complete uniformity throughout. Our strict density control assures you thoroughly non-porous Teflon—free from any flaws which might possibly affect your end use or product. Dimensions are accurate to your most critical tolerances—no rejects, waste of material or loss of time. You get product purity—Teflon at its best in every one of its remarkable characteristics. Delivery is prompt—you get the quantity you want when you want it.

Since the availability of Teflon, "John Crane" engineers have worked with Industry to successfully solve innumerable problems and develop new applications. *You can benefit from their experience and know-how.*

TYPICAL SIZES INCHES	
O. D.	I. D.
3/8	1/4
1/2	3/8
3/4	1/2
1	3/4
1 1/2	1
2 1/2	1 1/2
3	1 3/4

TUBING

Characteristics of Teflon

CHEMICAL
Completely inert.

ELECTRICAL
Very high dielectric strength.
Extremely low power factor.

THERMAL
Temperature range
−300° to +500° F.

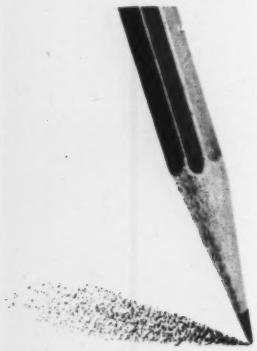
MECHANICAL
Strong, flexible, weather resistant.

LOW COEFFICIENT OF FRICTION
Absolutely non-stick.

* DuPont Trademark

Request full information and ask for our bulletin, The Best in Teflon.
Crane Packing Co., 6414 Oakton St., Morton Grove, Ill.,
(Chicago Suburb.)
In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

JOHN CRANE CRANE PACKING COMPANY 38 YEARS INDUSTRIAL PROGRESS



mechanical engineers

who are interested in working on new, exploratory technical developments are reading the Lincoln Laboratory folder. It describes some of our activities in:

SAGE
semi-automatic ground environment

AEW
air-borne early warning

SCATTER COMMUNICATIONS

WHIRLWIND COMPUTER

TRANSISTORIZED DIGITAL COMPUTERS

MEMORY DEVICES

HEAVY RADARS

SOLID STATE

If you would like a copy for yourself, or perhaps for some young man with a degree and little experience, let us know. Write:

RESEARCH AND DEVELOPMENT

M I T LINCOLN LABORATORY

BOX 8, LEXINGTON, MASSACHUSETTS

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Self-Aligning Fastener

For fastening applications involving non-parallel surfaces, a new line of counterbored, self-aligning, hexagon locknuts has been designed by Elastic Stop Nut Corp. of America, Union, N. J.

The new Type LH2395 fasteners are claimed to offer significant cost and weight savings and reduce production time by eliminating machining, milling, individual selection of tapered shims or other preparation of the forgings presently used to obtain the required parallel bolting surfaces.

The self-aligning nuts are designed to meet a demand created by a greater use of forged and extruded structural members in aircraft and industrial design, the company says.

The nut, varying the ball joint principle, has a base with a convex seat which mates with an alloy steel concave seat washer. The nut tilts 8 deg in any direction from centerline to compensate for angular misalignment of fastening surfaces. Manufacture of the washer base is carefully controlled to assure the parts will withstand the high bursting pressures. Tightening the bolt in the normal manner automatically seats the nut in the base and adjusts it to the proper angle.

The parts are adaptable to either short or long thread bolts by the incorporation of a counterbore in the nuts. In addition to reducing the bolt thread length requirement, the counterbore and washer base reduce the possibility of threads in bearing, the firm states.

The AN approved Type LH self-locking device is said to provide positive protection against the nut loosening due to vibration and offer extended re-usability. Performance of the self-aligning hex nuts is to AN-N-10 and/or MIL-N-25027 (ASG) specifications for temperatures up to 550 F.

Thread sizes currently designed for the Type LH2935 self-aligning hex locknut are 10–32, $^1/_4$–28 and $^5/_{16}$–24.

Cut-Off Machine

A cut-off machine, specifically designed for cutting ferrous metals, now equipped with fully automatic bar stock feed and power stroked head for completely automatic production line work, is available from Stone Machinery Co., Manlius, N. Y.

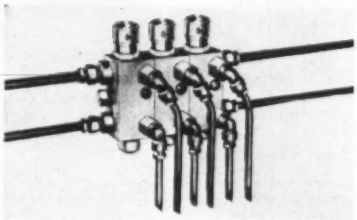
According to the company, speeds of 550 cuts per hour are maintained during production runs, with tolerances held to less than .005 in. Work is said to be turned out with a milled-like finish.

The machine has a wheel wear compensator which adjusts for fast approach and regulated speed of cutting operation by hydro check.

The cutting head is engineered with geared-in-head positive drive thad delivers all the power to the cutting wheel. The company says the unit, designated M-75, will cut $1^1/_2$ in. solid rounds with ease.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS



Lubrication Counter

A new lubrication cycle counter, designed to provide visual proof as a guard against bearing failure due to faulty lubrication and to provide an automatic and permanent record of bearing lubrication, has been announced by Alemite Div. Stewart-Warner Corp., 1826 Diversey Pkwy., Chicago 14, Ill.

The new lubrication-recording cycle counter is used with the firm's Tpe II Accumatic centralized systems of lubrication. It registers the exact number of times that the lubricant valve is discharged revealing at a glance that the lubrication system is functioning at precisely the predetermined intervals selected to meet specific requirements, the firm explains.

The new unit, furnished as a kit, can be installed without removing the valves from the centralized system. It provides a permanent operational record of each valve. The unit screws into the valve and extends 1 $^{5}/_{8}$ in. above it when in operation.

The counter face swivels to any position and the totally enclosed unit operates over a wide range of temperatures, the firm says.

The piston action of the valve actuates the counter mechanism at every lubrication cycle. The unit automatically resets to zero when the counter reaches 99.

Improved Power Drive

An improved power drive is announced by Toledo Pipe Threading Machine Co., Toledo, Ohio. Known as the Toledo No. 68, this portable drive, used for pulling, lifting, threading and turning on a variety of jobs, has been completely redesigned.

According to the manufacturer, the new streamlined frame is slightly heavier and more sturdy. New ball bearing design improves service life and minimizes periodic maintenance. The unit is said to be easier to hold and safer to operate because of a new handle design and relocation of the control switch to a convenient position on the handle.

The trailing wire is located out of the way of the operator and offered in either painted finish or highly polished aluminum finish. According to the company, adaptors for most standard die stocks, as well as square socket adaptors, add to the unit's versatility.

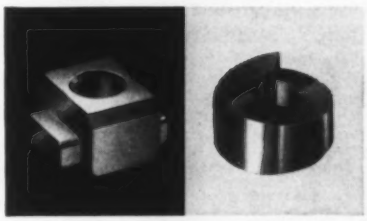
It is powered by a 115 v reversible a-c or d-c motor or 90 psi air motor and weighs 33 lb.

A NEW
FREEDOM
IN BEARING
APPLICATIONS

Availability of Sintered Powdered Metal Bearings and machine parts from a fully competent and technically responsible source opens the way to improvements in mechanical products.

Bunting facilities for designing, engineering and manufacturing of Sintered Powdered Metal Bearings and parts are as comprehensive and responsible as the traditional Bunting competence in the field of Cast Bronze Bearings.

A competent group of Bunting Sales Engineers in the field and a soundly established Product Engineering Department put at your command comprehensive data and facts based on wide experience in the designing and use of Cast Bronze and Sintered Powdered Metal Bearings and parts.



Write to our Product Engineering Department in Toledo or consult our nearest Sales Engineer.

Bunting®

BUSHINGS, BEARINGS, BARS AND SPECIAL PARTS
OF CAST BRONZE AND POWDERED METAL

The Bunting Brass and Bronze Company • Toledo 1, Ohio • Branches in Principal Cities

UNEQUALLED OPPORTUNITIES IN ENGINEERING

Now is the time . . . Convair is the place! Yes! If you are planning for a career in engineering look to Convair Pomona, the leader in Electronics. America's fastest growing young industry. Now engaged in Design, Development, Engineering and production of Electronic equipment and complex weapons systems. Convair-Pomona is the country's only exclusive guided missile plant, with the most modern, best equipped engineering facilities. Be first with Convair, live in the beautiful Pomona Valley only minutes from Los Angeles, the mountain, seashore and desert playgrounds. Country living near the city at its best!

Generous travel allowance to Engineers who are accepted. Write now enclosing a complete resume to:
Employment Dept. 3-Y

CONVAIR
A DIVISION OF
GENERAL DYNAMICS
CORPORATION
POMONA
CALIFORNIA

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Lubrication Unit

A Lubro-Control unit designed to meet the needs of manufacturers and users of machine tools for a small, compact, complete lubricating unit is now being marketed by C. A. Norgren Co., 3400 S. Elati St. Englewood, Colo.

The 6 × 6 × 5¼-in. cabinet-type 33AG-4 unit supplies air-actuated feed mechanisms, chucks, clutches, brakes and other air-operated parts of machine tools with filtered air, regulated air pressure and Micro-Fog lubrication. This lubrication is described as a finely divided air-borne oil fog that can be transported great distances with negligible precipitation in air lines and can be appropriately distributed to multiple lubrication points.

The unit also provides for visible oil feed for accurate flow control and proof of lubrication, lubricator performance over an air flow range of 4 cfm to 85 cfm, ⅝ pt oil reservoir, clear visibility of oil level. A choice is given for 64 or 25-micron filter element. Designed for main line air not exceeding 150 psi and for regulated air pressures of less than 125 psi the unit is available in ½-in. pipe size.

Hydraulic Lock Valve

Creeping of the loaded cylinder because of seepage in hydraulic systems, is said to be prevented by a new lock valve developed by Webster Electric Co., Racine, Wis.

The purpose of the lock valve, which can be applied to virtually any hydraulic lift system, is to supplement the seal on a standard directional valve to provide a positive lock of the cylinder until the flow is deliberately reversed.

According to the company, the valve has almost limitless applications for hydraulic cylinder lifting devices such as farm tractors, road-building equipment, lift trucks and mechanisms, and factory and machine tool apparatus. The valve can handle up to 20 gpm and will operate satisfactorily up to 1500 psi.

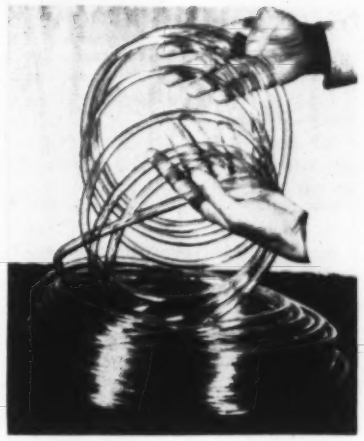
The lock valve has two valves, check and relief. Poppets on the check valve, which is held in position by a light spring, and on the relief valve are constructed of nylon.

The valve is provided with two inlet ports. The one not used can be either plugged or used as a pressure gage port. The lock valve can be located in the line supplying either the head end or the rod end, or both.

Construction of the valve is such as to offer minimum restrictions when operating the check valve and requires approximately 1200 psi before reverse flow is started, the company says. When reverse flow is once started, return pressure drops to about 150 psi because of the large piston. This feature is incorporated so that it will not require 1200 psi during the entire stroke to perform this operation, the firm states.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS



Vinyl Tubing

High quality, maximum clarity vinyl tubing for laboratory and plant application is now available from the American Agile Corp., Box 168, Bedford, Ohio.

The tubing will handle a wide variety of chemicals and reagents and has excellent flexibility and nontoxicity, the company says.

Available in both transparent vinyl and translucent polyethylene forms, it may be steam sterilized and is particularly suited for general laboratory usage, hospital surgical use, transmission of beverages for human consumption, and similar applications.

The tubing is available in sizes from $\frac{1}{8}$ ID $\times$ $\frac{1}{4}$ OD to 1 ID $\times$ 1 $\frac{1}{4}$ OD, with eleven standard sizes offered.

Signal Generator, Control

A signal generator and control system, manufactured by Bruel & Kjaer with features to meet the requirements of a signal source for electrical, electro-acoustical and acoustical measurements, is now available from Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

The instrument is a beat frequency oscillator designed for audio frequency measurements with particular emphasis on facilities for automatic frequency scanning and chart recording of data as when used with the firms high speed level recorder, Model BL-2304.

Typical applications for the instrument include all af response curve measurements; high frequency vibration testing; calibration measurements; automatic sound insulation testing; acoustical measurements; and automatic distortion measurements.

The completely logarithmic frequency range from 20-20,000 cps, can be swept continuously either manually or by means of an external drive. Other features of the Signal Generator include remote control facilities, an output control system to permit external signal feedback, and automatic frequency markers.

FIGHT VIBRATION WITH VIBRATION

Shaker system for complex motion tests

NEWEST TECHNIQUE in environmental testing is complex motion testing. It comes closest to reproducing actual vibrational environments encountered in operation of missiles, aircraft, vehicles.

An MB Vibration Exciter System designed for such service is one of optimum versatility. It fulfills not only the special needs of *random motion testing*, but virtually any other test specification as well . . . such as sinusoidal motion testing, fatigue testing, automatic cycling, and provisions of MIL-E-5272A.

HEART OF THE SYSTEM—THE EXCITER

The MB Model C-25HB (shown) is rated at 5000 pounds peak force. Its table assembly is unusually stiff to reduce resonances yet weighs only 75 pounds. Axial resonance lies well over 2000 cps operating range.

This and otner MB Exciters for 200, 1200, 1700, 3500, 7000 and 15,000 pound force ratings faithfully reproduce complex wave input signals because their *frequency response* is *flat*.

MATCHED PERFORMANCE

Other elements of the system are integrated with the exciter's high performance. An electronic *amplifier* fulfills the power demands. A control cabinet houses all necessary *instrumentation* plus frequency and amplitude *controls*. Circuits in a *compensation console* give automatic adjustment so that table acceleration remains proportional to input voltages. A top quality tape recorder for playback of the complex wave patterns may be used.

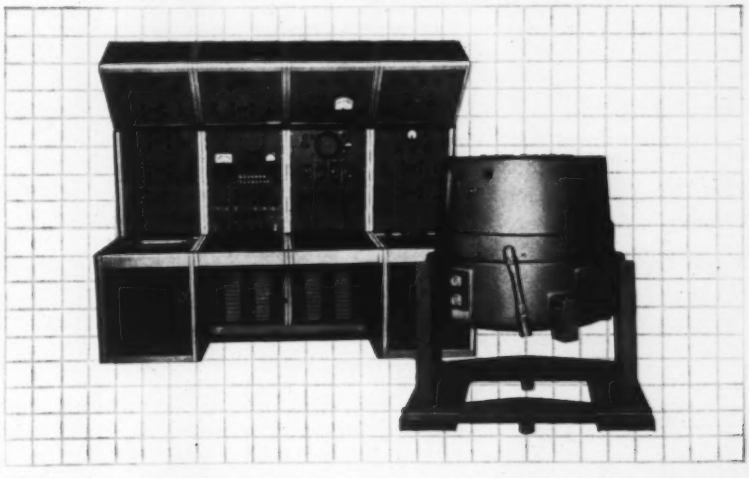
If you have any questions on vibration testing at all, come to a leading authority on the subject . . . the MB engineering staff.

MB *manufacturing company*

A DIVISION OF TEXTRON INC.

1060 State Street, New Haven 11, Conn.

HEADQUARTERS FOR PRODUCTS TO ISOLATE . . . EXCITE . . . AND MEASURE VIBRATION



To the engineer who likes to blaze *new* trails...

Six inch long compressor-turbine assembly in a midget AiResearch air expansion refrigeration unit which operates at 100,000 r.p.m., can drop temperature more than 600° F. in a second.

▶Great engineering advances are now taking place in America, and The Garrett Corporation is playing a vital part in making them possible.

Reason for our important role is the forward looking approach of our engineers, who develop new solutions for industry as needed. If stimulating assignments and recognition are what you're looking for, you'll enjoy working with us. And if you like pleasant living, too, our plants are located in the most desirable areas in America.

All modern U.S. and many foreign aircraft are Garrett equipped. We have pioneered such fields as refrigeration systems, pneumatic valves and controls, temperature controls, cabin air compressors, turbine motors, gas turbine engines, cabin pressure controls, heat transfer equipment, electromechanical equipment, electronic computers and controls.

We are seeking engineers in all categories to help us advance our knowledge in these and other fields. Send resume of your education and experience today to: Mr. G. D. Bradley

THE GARRETT CORPORATION

9851 S. SEPULVEDA BLVD., LOS ANGELES 45, CALIFORNIA

DIVISIONS:

AIRESEARCH MANUFACTURING, LOS ANGELES • AIRESEARCH MANUFACTURING, PHOENIX

AIRESEARCH INDUSTRIAL • REX • AERO ENGINEERING

AIRSUPPLY • AIR CRUISERS • AIRESEARCH AVIATION SERVICE

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Adjustable-Lever Switch

A new, adjustable-lever-actuated basic switch is being marketed by Micro Switch of Freeport, Ill., Division of Minneapolis-Honeywell Regulator Co.

The switch's operating position is adjustable between .670 and .880 in. Operating position is controlled by means of an adjustment screw without removing the switch from its mounting.

The switch, designated BZ-2RW899-A2, is particularly well suited for use on timers, computers or other multi-mounted switch devices, the company says.

It is available in either straight or formed lever designs, and either with or without a roller. A choice of solder type or screw terminals is available as well as a wide selection of preset operating characteristics.

Contact arrangement is single-pole double-throw. The switch can also be supplied with split-contact double-throw circuitry.

Characteristics are as follows: operating force, $2^1/_2$ oz max; release force, $^1/_2$ oz min; overtravel, .460 in. max, and differential travel, .007 to .50 in.

All models of the switch are listed by Underwriters Laboratories at 15 amp 125, 250 or 460 v a-c; $^1/_2$ amp 125 v d-c; $^1/_2$ amp 250 v d-c.

Fastener Design

Pheoll Mfg. Co., Aviation Div., Bendix Bldg., Los Angeles 15, Calif., has announced a new type of recess design for screws, bolts, blind bolts, cowl fasteners and all other turning types of fasteners, which is said to deliver higher torque values than have ever been possible.

While the amount of torque possible naturally varies with the size and type of screw or bolt, it is claimed that the new design, called Hi-Torque, makes possible torquing values of at least two times torque requirements for all types and sizes.

The fastener features a recess with an accurate slot undercut on both sides and with driving surfaces parallel, and employs a 360-deg driving blade. These innovations result in full bearing thrust of the driving blade against the driving surfaces, elimination of the camming action which tends to force the blade out of the slot, plus longer driving blade life, the company says.

Other advantages claimed for the recess are greater head strength, smaller head sizes and positive inward thrust in driving or removal. The recess can be driven from either a horizontal or vertical driver position or from any angle by use of a universal joint.

The fastener is now available and used as national aircraft standard high torque bolt (NAS 583 through NAS 590). Special sizes are available on request and all types and sizes are available in such materials as alloy steels, stainless steels, Greek Ascolloy, A-286 and titanium.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Heating Boilers

Twenty-six new Scotch type heating boilers for firing with natural or forced draft gas or oil burners are now being marketed under the name "Queen of Scots" by National-U.S. Radiator Corp., Johnstown, Pa.

These boilers are said to meet the heating and hot water supply requirements of commercial, institutional and industrial installations. Type SN is available in 13 sizes for use with popular makes of commercial sized oil or gas burners employing natural draft. Net SBI steam ratings extend from 4500 to 35,000 sq ft and SBI net water ratings from 7200 to 56,000 sq ft.

When forced draft oil, gas or gas-oil firing is specified, Type SF boilers are available in 13 sizes. These have net steam ratings ranging from 6440 to 50,000 sq ft and net water ratings extending from 10,300 to 80,000 sq ft. The boiler maker certifies that thermal efficiencies in excess of 80 per cent can be developed with these Type SF boilers when fired with certain burners of known quality—properly installed and adjusted.

The firm claims the outstanding feature of the units is the "wet back" design that assures the rear combustion chamber being completely surrounded by water-backed heating surface. This construction is said to improve performance, reduce heat escape to boiler room, and eliminate refractories.

All the new boilers have an unusually low overall height. The boilers have hinged front doors for inspection and cleaning of the 3 in. steel boiler tubes. There is a rear access opening for inspection and access to the firebox. It has a 4 in. observation port with protecting shutter in the refractory-protected door. Tankless and storage water heaters are available for both types of boilers. The boilers conform to the ASME code for steel heating boilers.

Computing Indicator

Precise measurements of speed, rpm, pressure, thickness, and other quantities can be read directly in the desired units without conversion calculations on a new DY-2500 electronic counter introduced by Dynac, Inc., a subsidiary of Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif. The unit is equipped with a variable gate time that functions as multiplier of the transducer input to provide direct readings.

Features include a front panel plug-in board that automatically sets any predetermined conversion multiplier. Gate time may also be selected manually and is adjustable from .0001 to .9999 in .0001 second increments. There is also provision for a second input to permit measuring ratios of two independent variables and direct readings of such quantities as engine revolutions per gallon.

The firm states that a push button on the front panel permits a quick check of proper operation. The instrument is available in cabinet or standard rack mounting.

... make every step a safe step

BLAW-KNOX ELECTROFORGED® STEEL GRATING and STAIR TREADS

On stair treads, walkways, catwalks, platforms and floors—both indoors and outdoors—you can provide safe walking conditions. For Blaw-Knox Electroforged Steel Grating brings you these exclusive features:

1. rigid one-piece construction—easy to install
2. non-slip twisted crossbar—for safe footing
3. three types of bearing bars
   - square bars—for smoothest walking surface
   - knurled bars (Furro-Grip)—for extra safety plus relatively smooth walking surface
   - serrated bars—for maximum safety under extremely hazardous skid conditions
4. no sharp corners to clog—self-cleaning
5. all surfaces accessible—easy to paint
6. maximum open area—for light and ventilation

Write for your copy of new Bulletin No. 2486
—or send dimensional sketch for quotation.

50th Anniversary BLAW-KNOX 1906-1956

BLAW-KNOX COMPANY

BLAW-KNOX EQUIPMENT DIVISION

Pittsburgh 38, Pennsylvania

GRATING APPLICATIONS: floors • platforms • walkways • catwalks • stair treads • fan guards • shelving • and many other uses, both outdoors and indoors, for versatile steel grating

Close-up shows two of five pairs of Ajax Dihedral Spindle Couplings driving 23" and 56" x 52" 4 high 5 stand tandem cold mill built by United Engineering & Foundry Co. for Weirton Steel Co., a Division of National Steel Corporation.

▶ The critical eyes of steel men are focused on the design, performance and output of every new mill and all its components. This new 4 high, 5 stand tandem cold mill, designed for speeds up to 7200 fpm, was built by United Engineering and Foundry Co. for the Weirton Steel Co., a Division of National Steel Corporation.

It is turning out sheet of high quality finish and maintaining close gauge tolerance.

Power is transmitted from drive stands to rolls by 10 Ajax Dihedral Spindle Couplings handling 2500 H. P. each. The uniform angular velocity of Ajax Dihedral Spindle Couplings is an important factor in producing smooth finish, uniform thickness and long roll life.

Ajax Dihedral Spindle Couplings are in operation in America's foremost steel mills. They have been proved and approved by every test of time and service. Whether you are designing, specifying, building, using or modernizing mills, it will pay you to get the facts on Ajax Dihedral Spindle Couplings. *Write for Bulletin No. 58.*

AJAX

AJAX FLEXIBLE COUPLING CO. INC.
WESTFIELD, N. Y.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

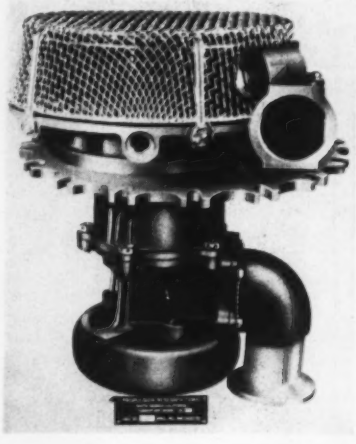
Cementable Teflon Tape

Cementable Teflon tape, either single or double-faced, in practically any thickness from .0005 to .060 in. and in widths from $^1/_2$ to 12 in. has been announced by the Enflo Corp., Route 38 at Airport Circle, Pennsauken, N. J.

Either or both surfaces of the tape are treated by a special process which makes the Teflon readily bondable to glass, steel, aluminum, plastics or practically any other material including Teflon itself, the firm states.

Ultimate shear strength is on the order of 280 to 330 lb per sq in. Peel strength is approximately 40–45 lb per sq in.

The tapes are normally furnished in continuous rolls, although cut-to-size sheets also can be furnished to order. Standard thicknesses available are .0005, .010; .015; .020; .025; .030; .035; .040; .045; .050 and .060.



Fuel Transfer Pump

A reliable, simplified fuel transfer pump with a minimum of moving parts to provide specified quantities of fuel at various altitudes has been developed by Propulsion Research Corp., a wholloy owned subsidiary of the Curtiss-Wright Corp., Santa Monica, Calif.

First application of the Model 102 turbo pump is on the Douglas A4D Skyhawk fighter bomber. Rated fuel flow is 10,000 lb per hr at any altitude from sea level to 48,000 ft. Airflow is less than 6 lb per min and maximum environmental temperature is 250 F. The unit is 8.1 lb complete with pump and turbine. It is 10 in. high and 7 $^3/_4$ in. in diam.

Of unique design, the pump incorporates its own simplified overspeed control requiring no linkages or electrical power supply, the company says. Driven by compressor bleed air, the unit can run dry without lubricant for extended periods without damage.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Hydraulic Presses

Hydraulic Div., Kingsbacher-Murphy Co., 6245 Lexington Ave., Hollywood 38, Calif., announces the addition of two larger machines to its line of hydraulic presses. The new 30 and 50 ton models are said to be versatile and especially useful for rubber and plastic molding, testing, and laminating, either on a production or laboratory basis.

The presses contain a 5-in. ram and 5-in. stroke, and develop up to 60,000 and 100,000 lb pressure on the platens, respectively. The platens are made from a special semi-steel, are precision ground, and available in both the $12^1/_2 \times 12^1/_2$ in. and $12^1/_2 \times 18^1/_2$ in. sizes. Cast-in heaters made to operate on 220 v a-c permit heating up to 600 F. The temperature controlled by means of individual adjustable thermoswitches, is indicated by thermometers located on the front edge of each platen. In addition, the platens contain coils for water cooling and can be adapted for steam heating. Both the temperature and pressure are uniformly distributed throughout the working area.

The hydraulic system features a two stage pump, automatically switching from low to high pressure, and a newly designed release valve, both of which contribute to a faster and easier operation.

Each platen has its electrical components mounted on a separate chassis inside the cabinet. These parts are accessible for inspection and servicing through a hinged door.

The space between columns measures $13^1/_4$ in. allowing for the use of large molds and dies, and models are available with single and multiple openings. It has a frame of welded steel.

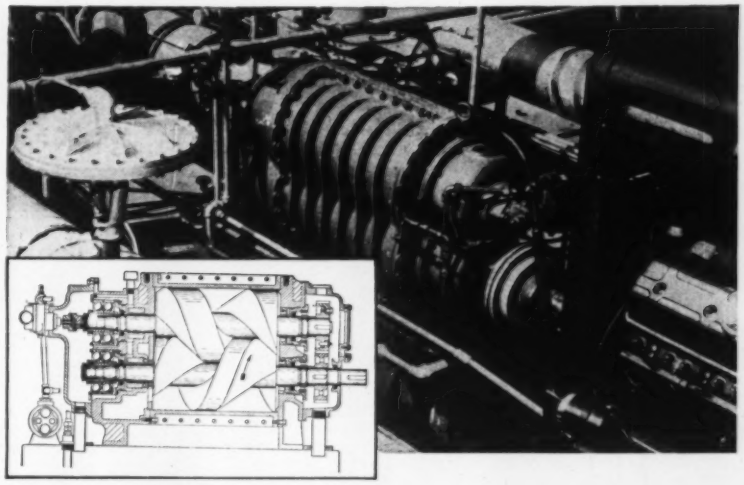
The company says that, when desired, special testing equipment can be installed on any model.

Vibration Mount

Korfund Co., Inc. 48-35M 32nd Place, Long Island City 1, N. Y., announces the development of its new universal Lev-Elasto damper, a universal, low cost machinery mount said to speed installation and relocation of all types of equipment, stops vibration transmission, and to lower noise levels.

Features of the damper claimed to be obtainable with no other rubber leveling machinery mount include internal leveling adjustment permitting installation anywhere under the machine, regardless of position or availability of bolt holes in base, or of base thickness; no adjusting bolts protruding from top of the mounting. According to the company, bolting of machine to mounting is not necessary because of a non-skid felt pad on the top plate; however, the mounting *can* be cemented, or bolted through the tapped hole provided. The damper can be cemented to the floor if desired, the firm states.

The units are available in nine sizes for loads ranging from 65 to 12,000 lb per damper. Prices range from $6 to $35.



MODERN SPIRAXIAL® COMPRESSORS

BUILT WITH R-C *plur-ability*

Users of these latest Roots-Connersville Spiraxial Compressors tell us of their amazing efficiency and economy, at ranges of 700 cfm to 5,000 cfm, and pressures from 15 psi to 30 psi (or higher).

Then, there are these other R-C *plur-ability* advantages:

- No internal lubrication, hence oil-free air
- Direct-connected for speeds of 1750 rpm and 3550 rpm
- No water jacketing needed
- Compact—requires less space
- Minimum noise level

With many applications possible because of these advantages, we suggest you study the performance curves and other details in Bulletin SC-354. You may well find that the long-time economy of R-C Spiraxial units will justify replacing less efficient equipment.

Ask about *plur-ability* in all R-C equipment

Centrifugal and Rotary Positive Blowers, Gas Pumps and Exhausters
•
Positive Displacement Vacuum Pumps and Meters

Inert Gas Generators
•
Spiraxial® Compressors
•
Detailed bulletins available on all R-C equipment.

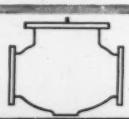
ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.

1056 Michigan Ave., Connersville, Indiana. In Canada, 629 Adelaide St. W., Toronto, Ont.

YOU JUDGE THE BETTER BUY!

FOR A 6" VALVE INSTALLATION OPERATED AN AVERAGE OF 55 TIMES A DAY FOR 9 YEARS

Case History	GATE VALVE "A"	 G.A. FLOWTROL VALVE
REPAIRS	FREQUENT	NONE
REPLACEMENT	EVERY 3 MONTHS	NONE
ORIGINAL COST	$60.00	$360.00
APPROXIMATE TOTAL COST	over $2,000.00	$360.00

To Find Out More WRITE...

GOLDEN ANDERSON Valve Specialty Company

1223 RIDGE AVE., PITTSBURGH 33, PA.

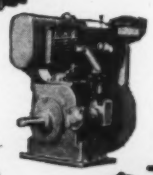
Designers and Manufacturers of **VALVES FOR AUTOMATION**

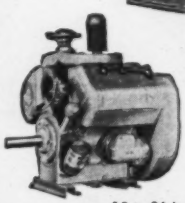
POWER to Match Your Equipment

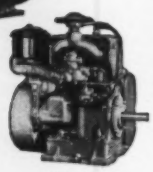
WISCONSIN HEAVY-DUTY Air-Cooled ENGINES

• The extreme compactness and relatively light weight of these engines enable the original equipment builder to develop smaller, lighter equipment to replace heavier, bulkier machines powered by more cumbersome engines . . . or to include Wisconsin Engines as power components on new equipment . . . without sacrificing heavy-duty performance and dependability. Thirteen models, (3 to 36 hp.) offer power selectivity to match your equipment.

Tell us about your power problem. Detailed "Specs" and engineering data gladly supplied.







WISCONSIN MOTOR CORPORATION

World's Largest Builders of Heavy-Duty Air-Cooled Engines

MILWAUKEE 46, WISCONSIN

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Audio Filter Set

A one-third octave filter set, Model BL-1609, manufactured by Bruel & Kjaer, has been introduced by the Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio. It is specially designed for sound and vibration analysis, measurement of sound transmission and reverberation time, and in general, any audio signal analysis or telemetry data reduction.

The filter set consists of 27 flat-topped filters of $\frac{1}{3}$ octave band pass width with seven additional filters available as optional equipment to cover the frequency spectrum 14 cycles to 36,000 cps. Besides the band pass filters, the instrument contains the standardized weighting networks for overall loudness measurements in phons and a linear band pass. The filter response is within plus/minus 2 db of the linear level.

The filters can be manually selected by means of the 50-position switch or automatically scanned by an external drive motor. The stepping switch is a nonshorting type and accordingly, the output of all filters can be simultaneously transmitted to readout equipment.

Electric Counters

A remote electric counter is designed with a positive clutch drive that permits it to record up to 200 weighings per min, according to an announcement from its manufacturer, Richardson Scale Co., Van Houten Ave., Clifton, N. J.

The new counter is said to permit the user to tabulate and record a weighing process from any point in his plant. It can be used to keep production records, as well as tabulate.

The counter's high recording rate is attributed to the speed and accuracy of the clutch arrangement, which prevents "double count" even when the counter is actuated by chattering contact or a washing mercury switch. The counter can also be engineered to tabulate in pounds.

The new counter comes in two models, 31–41 and 31–42. Model 31–41 has two rows of digits, one for an accumulative total and one for individual weighings. Model 31–42 records only individual weighings.

The counter works on an electro-mechanic principle, with the signal sent from the user's single-pole, double-throw counter impulse switch located at the scale. A solenoid relay in the counter transforms this impulse into mechanical power. When actuated, the armature of the relay releases the driven member of the positive clutch, permitting it to engage with the driving member.

When the positive clutch is engaged, the main shaft, on which the counting cam is mounted, makes a half revolution and moves the dial numbers of the counter respectively. When the second impulse is received the remaining half revolution is made, registering the full count. It then rests until another signal is received from the counter impulse switch.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Friction Power Take-Off

Twin Disc Clutch Co., Racine, Wis., announces the addition of a new model to its SP Line of heavy-duty friction power take-offs—the SP-321. The SP Line was designed specifically to meet the increased power transmission requirements of higher speed, higher horsepower industrial engines.

The new power take-off can handle up to 6730 lb-ft of torque and transmit up to 602 hp at 1550 rpm, the company says. It's available with a standard SAE No. 00 flywheel housing adapter to meet the widest range of industrial power units in its horsepower and rpm ratings.

Other features include a triple driving-plate construction to provide ample friction surfaces to withstand excessive heat, a pilot bearing with double-width bearing race for greater lubrication retention and long life, and a spherical roller bearing at the clutch output shaft for greater overload and side-pull capacity.

Compacting Press

Model 300-H, hydraulic, metal-powder compacting press has been developed by Baldwin-Lima-Hamilton Corp., Hamilton, Ohio.

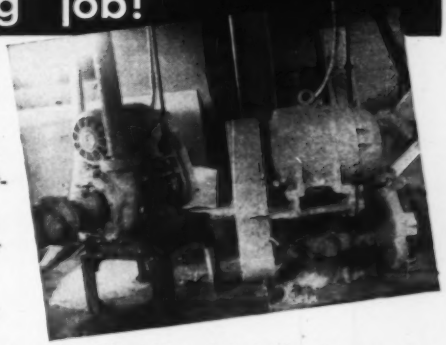
According to the company, design of the press follows the new concept of compacting introduced by the firm in its Model C and L mechanically operated presses. The 300-H press extends the range of part sizes and shapes which can be compacted.

The firm says the new press enables fabricators to produce, for the first time without additional tooling, such shapes as a double counterbore and a double hub. Variation of these shapes are possible, a double-hub part can be made with both counterbored and through holes. Or, a double-counterbored part also can have offset or flanged section on the outside.

The unit is a 300-ton, four-column hydraulically operated press with the main pressing platen moving down from the top. Mounted on the platen are four auxiliary cylinders, two of which are connected to an inner top punch platen and two to an outer top punch platen. The main platen exerts a force of 300 tons, and the auxiliary cylinders can be adjusted up to a maximum pressure of 125 tons. Adjustable stops from the main platen to the two punch platens, of 300 tons capacity, permit loading either top punch up to this capacity as long as the total of the two does not exceed 300 tons.

The die platen, held in its top position by two air cylinders, is equipped with 300 ton adjustable stops to limit its downward movement. The bottom, or ejector platen, is operated hydraulically with a maximum force of 300 tons. Both floating and stationary core rods can be used as needed. The floating core rod can travel with the part during ejection, until the part has cleared the die and expanded enough to release its hold on the rod.

NAGLE PUMPS won out on this "pump-killing" job!



Since 1946 Nagle 4" type "T", frame 119 L horizontal shaft, centrifugal pumps have yielded high performance handling a highly abrasive and heavy mixture of asbestos and portland cement, at a plant of Flintkote Co.—just the kind of gruelling application for which NAGLE PUMPS are designed. Water-end parts are abrasion resistant, highly effective stuffing box is readily accessible and slippage seal easily adjusted. Split bearing stand can be quickly dismantled, but that's seldom necessary.

NAGLE PUMPS are establishing fine performance records in abusive applications where ordinary pumps fail, such as in chemical and petrochemical plants, atomic energy plants, mines, mills and quarries. **Send for Catalog 5206.**

NAGLE PUMPS

NAGLE PUMPS, INC.
1299 CENTER AVE., CHICAGO HEIGHTS, ILL.

PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

Select California engineering group explores thermodynamic cycles in advanced engines

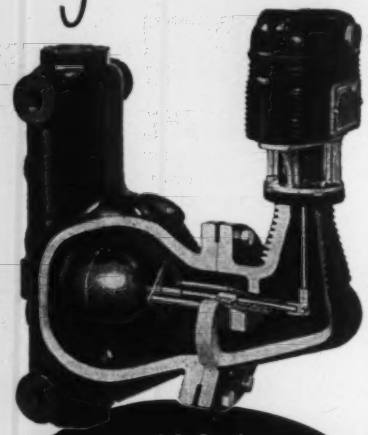
positions now open for Cycle Analysis... Thermodynamics... and Nuclear Engineers

Propulsion experts at North American Aviation's Los Angeles Division are carrying out thermodynamic analyses of highly advanced engines. The studies include investigation of turbojets, ramjets, rockets and nuclear propulsion devices...compressors, combustors, turbines, afterburners, exhaust nozzles and thrust augmentation devices.

The Engineering Personnel Department at North American's Los Angeles Division is seeking several qualified engineers who are interested in this work. They are looking for men who have had a minimum of three years thermodynamics cycle analysis experience in jet engines or propulsion analysis. Advanced degrees are preferred, though not required.

Interested engineers are invited to contact Mr. W. H. Nance, North American Aviation, Inc., Los Angeles Division Engineering Dept. 56-ME, International Airport, Los Angeles 45, California.

McDonnell goes High Pressure



No. 92 Series Pump Control, Cut-off and Alarm Switch
For pressures to 250 psi.

- Repulsion magnetic switching—for positive opening *and* closing.
- Unprecedented heat dissipation—okayed for 75° C. (167° F.) wiring at terminals.
- Extra generous clearances in float chamber.
- Operating levels unaffected by pressure changes.
- McDonnell quality throughout.
- Four models—with or without integral water column.

Use this new 92 Series for controlling boiler feed pump, or electric valves; for low water cut-off or alarm; for tank level control, etc. For lower pressures—to 150 psi.—use companion 91 Series. New catalog has full engineering data.

Write for Bulletin L-123

McDONNELL & MILLER, Inc.
3510 N. Spaulding Ave. • Chicago 18, Ill.

Doing One Thing Well

McDONNELL
Boiler Water Level Control

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Teflon Tubing, Pipe

Haveg Industries, Inc., 900 Greenback Rd., Wilmington 8, Del., announces production of Teflon pipe and tubing and Teflon lined steel pipe. Pipe is being made in sizes up to 4 in. diam; lined pipe in 2 in. sizes. It is also available in rods and special machine parts.

Teflon, DuPont tradename for tetrafluoroethylene resin, is said to have a combination of electrical, chemical, and thermal properties unmatched by any other single material. It is inert to practically all chemicals, has no known solvent, and is attacked only by molten alkali metals and fluorine at elevated temperatures and pressures.

Relatively flexible, Teflon retains its toughness and flexibility over a wide range of temperatures, the firm states. It is resistant to abrasion and thermal shock, and will withstand 150 psi over a range of temperatures even below −90 F, and is capable of continuous service to 500 F. Reinforced structure of steel pipe lined with Teflon makes for even greater resistance to shock and vibration, according to the company.

Its electrical properties are essentially unchanged at temperatures up to at least 400 F.

The pipe, tubing, and rods, and lined steel pipe can be cut to desired lengths in the field and readily flanged.

Nitric Oxide Process

A new process, developed by Lurgi of Germany and offered in the United States by Blaw-Knox Co., Chemical Plants Div., 300 Sixth Ave., Pittsburgh, Pa., removes from coke-oven gas the nitric oxide which, if permitted to flow into the hydro-desulfurization cycle, would react with the gum-forming constituents in the BTX vapors, and cause fouling of the catalyst bed and plugging of the equipment.

According to the company, the process means that all the main materials needed to produce sulfur-free benzene for the nylon market can be available as by-products of coke-oven gas. Benzene, which is converted to adipic acid, is a raw material for nylon production.

Hydro-desulfurization, the firm states, gives the coke-oven-gas benzene from BTX a positive advantage over the petroleum derivatives. Heretofore, with the market price the same for each, the higher freight rate on the low-sulfur-content petroleum benzene gave the coke-oven-gas derivatives a slight economic edge in the nylon market, the company points out, adding that this small advantage prevailed even though the latter gave lower yields in the manufacture of nylon.

A light hydrogenation of the vaporized BTX by a hydrogen-rich-gas stream over a catalyst converts the sulfur to hydrogen sulfide, a compound easily separable from the liquid form of the product. The old method of removing the sulfur was to acid wash the

Did you know that

The Engineering Societies Library

can serve you by air mail and air parcel post? Over 170,000 engineering texts, and files of every worthwhile periodical are available for further research to meet your specific needs—patents, design, research, construction, and management problems. Charges cover only the cost of the services and represent but a fraction of the value you will receive.

The Engineering Societies Library
29 West 39th Street, New York 18, N. Y.
Mr. Ralph H. Phelps, Director

Please send me information pamphlet on services available, how air mail can expedite them, and their cost.

Name .....
Street .....
City .....
State .....
ME-10

BTX. The hydrogenation method gives a much purer BTX, and the use of coke-oven gas as a source of hydrogen for the process, increases its economic advantages. Furthermore, the firm states, the yield of the refined product is greater than with acid washing, and the coke-oven gas can be returned to the plant lines. Rather than being decreased, its heating value has been increased by the amount of gaseous reaction products carried off by the tail gas.

By-Pass Valves

A line of three-way by-pass valves designed for the accurate control of liquid flow has been announced by the Johnson Service Co, Milwaukee 1, Wis.

According to the company, total capacity of the valves is constant, regardless of the position of the inner valve, and flow can be directed to either of two outlets as required. The valves are designed to be 100 per cent tight closing.

The firm says maintenance is simplified by a unique construction feature that makes it possible to change the disks and seat rings without removing the entire valve from the pipe line. Slamming and water hammer noise is said to be eliminated by seating both disks against the flow.

The new valves, with molded rubber diaphragm operators, are available now in $2^1/_2$, 3 and 4-in. sizes. Other sizes are scheduled for production at an early date. Maximum pressures range up to 250 psi at 406 F and 400 psi at 70 F. Maximum control air pressure is 25 psi. The valves are furnished for either proportional or two position control.

Package Belt Conveyor

A "three-deck" package belt conveyor has been added to the line of the Goodyear Tire & Rubber Co., Akron 16, Ohio.

Called Wedge-Grip, the three-stage design of the belt cover gives it gripping power to handle all types of packages from cans to rough cloth bags on inclines ranging from 30 to 35 deg, the company states. Certain types of smooth, hard packages can be carried by the new belt on inclines up to 45 deg.

Criss-crossing ribs form small, open-center diamonds on the surface of the belt. The ribs are constructed with a step-down design, so that as each step in the ribs wear down, a new rib is presented for use. This design, the firm says, also makes the top and second ribs more stable because of their broader supporting bases.

The cross-angle rib design is siped or sliced at regular intervals to provide individual gripping fingers which adjust themselves to uneven surfaces.

Constructed of a soft, abrasion-resistant rubber compound, the belt is being manufactured in square edge slabs and cut to width up to 60 in. with edges coated black.

NUCLEAR CHALLENGE

There are still a lot of problems to be solved in the design of any reactor. But the difficulties are multiplied many fold when it comes to developing a practical nuclear aircraft engine. Shielding, weight limitations, other factors make it one of the toughest engineering problems of today.

Are you the type of engineer who wants a challenge to his mental abilities? Are you looking for an opportunity to do original, creative thinking on an outstanding engineering team where new ideas are encouraged? Then we may have an interesting, profitable future for you here, particularly if you are an . . .

AERONAUTICAL ENGINEER
CHEMICAL ENGINEER
MECHANICAL ENGINEER
ENGINEERING PHYSICIST
METALLURGIST

A few of the many personal benefits . . .

- New higher salary levels
- Association with engineers and scientists of recognized ability
- Nearby R.P.I. graduate school for advanced study
- Suburban living in central Connecticut
- The prestige of an internationally known growth corporation

★ ★ ★

Please send your resume to Mr. P. R. Smith, Office 14, Employment Department

PRATT & WHITNEY AIRCRAFT
DIVISION OF UNITED AIRCRAFT CORPORATION, EAST HARTFORD 8, CONNECTICUT
World's foremost designer and builder of aircraft engines . . . .

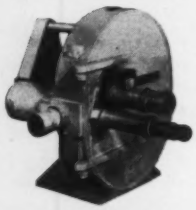
THE *NEW* WAY INDUSTRY *SAVES* TIME...MONEY
...SOLVES MECHANICAL AND DESIGN PROBLEMS...

PHOTO INSTRUMENTATION

. . . the science of gathering data photographically, either by picture or oscillographic trace, and recording on film for further study.

FASTAX HIGH SPEED MOTION PICTURE CAMERAS

FASTAX cameras are most versatile because there's nothing too small or large for them to photograph . . . because they have the highest speed ranges—from 150 to 16,000 pictures per second . . . because they take brilliant images in color or black and white.

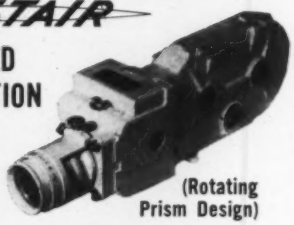


High Speed Cine Oscillographic Cameras . . . 400 ft. Capacity

With the combination cine and oscillographic camera there is a simultaneous recording of mechanical action and its related electrical characteristics. Camera can be used as either a high speed motion picture, streak or combination camera.

FASTAIR

HIGH SPEED 16mm MOTION PICTURE MISSILE CAMERAS



(Rotating Prism Design)

Top picture quality . . . sturdy construction will withstand up to 100 G's . . . flat speed characteristic curve . . . speed range 12 to 600 per second.

MIRROTEL LENSES

Mirror optics in a lens has a number of advantages over comparable telephoto lens. It is shorter, lighter in weight, much more stable and is completely free of chromatic aberration, coma astigmatism and distortion. 40" and 80" lenses available.

CLOSED CIRCUIT TV RAPTARS

Wollensak TV Raptars were designed and produced to take better television pictures . . . give full coverage . . . assure sharp picture from center to edge of screen. Available from ½" to 6". Lenses for studio TV available from 2" to 24".

WRITE for more complete information or bulletins on Cine Lenses, TV Lenses, Pro-35 Lenses or FASTAX Cameras.

WOLLENSAK
OPTICAL CO., ROCHESTER 21, N. Y.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Ultrasonic Cleaner

A new ultrasonic cleaner, the CBl-60, developed for the maintenance cleaning of aircraft engine parts, has been announced by Industrial and Scientific Products Div., Curtiss-Wright Corp., Caldwell, N. J.

The new unit has a single stage tank, 20 × 24 × 40 in. providing a working space of 12 × 12 × 12 in., and utilizing barium titanate transducers.

Concentrating high ultrasonic power in one cubic foot of area, the unit is claimed to offer one of the highest cleaning potentials in the field.

The unit includes a circulating and solvent cooling system, drainable and protected pitch sludge sump, explosion-proof pump motor and switch, automatic cut off-and-on switch for the ultrasonic generator, solvent filter, valves and soundhead protectors.

It requires 5 kw at 220 v, 60 cycle, single phase input. The ultrasound power output reaches 5 kw peak at 40 kc per sec. The generator can be operated remotely by the tank operator. The two major units may be operated up to 100 ft apart. The CBl-60 is also equipped with a solvent cooler which contains a water cooled head exchanger.

Two and three stage units utilizing vapor degreasing and ultrasonic solvent cleaning are available to fit particular circumstances.

Heating Shutoff, Alarm

What is described as the first safety shutoff and alarm for automatically controlled processes which requires no sensing elements or electronic circuitry has been introduced by Damol Corp., 541 Land Title Bldg., Philadelphia 10, Pa.

Designated as the Impulse Monitor, the device is said to provide a complete, safe shutdown of the process and sounds an alarm in the event of controller failure in the "on" period; and an alarm in the event of abnormal "off" period or fusing of the power contactor.

Although the present models are designed primarily for heat treating furnaces, the principle of the monitor can be applied to any process involving heat, pressure or flow where the control system uses an on-off, two position or pulsing type of control mode and where the input is of reasonably uniform duration, the company states.

Featuring simplicity of design and operation, the monitor can be easily installed with only slight change in wiring. Maintenance is said to be negligible. According to the company, the absence of sensing elements such as thermocouples and thermal bulbs and of electronic circuitry assures positive, dependable operation with no possibility of failure from added components. The device operates independently of furnace temperatures.

The operation of the impulse monitor is a direct function of the signal from the automatic controller. It continually monitors the input to the controlled process and acts

KEEP INFORMED | NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

instantly to shut down the process and sound an alarm when an abnormal condition arises. It can be wired to operate an external alarm circuit or to signal failure over telephone lines or protective agency equipment.

A toggle switch permits by-passing the monitor during the initial process rise and during erratic charging of the process. The monitor must be reset manually after each safety shutdown, thus permitting the examination of the control equipment to determine cause of failure.

Priced comparably to existing safety devices, the monitor is claimed to be equally effective on electric, gas or oil furnaces. Three models are available. Model 202B to shut down and signal alarm in the event of controller failure in the "on" portion of the cycle; Model S-203A for the same purpose as Model 202B plus alarm if the power contactor freezes; Model S-204A for the same purpose as Model S-203A plus alarm in the event of abnormal "off" cycle period. All components of the three models are approved by the Underwriters' Laboratories.

The monitor is illustrated and described in catalog No. 256 available from the company.

Glass Mat Laminate

A new arc and flame resistant grade of Phenolite is available from National Vulcanized Fibre Co., 1056 Beech St., Wilmington 99, Del. Identified as GP-9204, it is the newest addition to the firm's recently developed line of polyester glass mat laminates.

Although all these sheet laminates have dimensional stability, exceptionally high impact strength and above average arc resistance each grade features one outstanding property, the company states. The new grade features Underwriters' Laboratory approval as a flame resistance material. It is approved for the sole support of current carrying parts at temperatures up to 150 C. The new laminate also has good dielectric loss properties under dry conditions and reasonably good dielectric strength under wet conditions, the company says.

The features of other grades in the new line are said to be: GP-9100—a general purpose, medium cost sheet with good electrical and mechanical properties; GP-9104—low cost grade with lower mechanical properties than GP-9100 and with fair electrical properties; GP-9202—the best electrical grade, except for arc resistance, and also offering excellent flame resistance.

Grade GP-9204's dimensional stability and impact strength suggests important uses in mechanical applications, such as supports, panels, and cams, the firm points out. Its electrical and flame resistance make it applicable for armature slot wedges, spacers, switchboard panels, switch insulators and arc chutes.

Grade GP-9204 is said to have good chemical resistance to most acids and solvents such as carbon tetrachloride, toluene, gasoline and ethyl alcohol and fair resistance to weak alkalies.

NEWEST OF THE GARLOCK 2,000

NEW Cementable TEFLON*

FOR HUNDREDS OF LINING JOBS

Here's a new lining material that is so slippery on one side that nothing sticks to it, yet the other side can easily be bonded to wood, glass, metal or other surfaces. Ideal for lining hoppers, paint spray booths, conveyor guide rails . . . anything that comes in contact with sticky fluids, solids, or foodstuffs.

MORE SANITARY, TOO. Teflon can't harbor bacteria; is tasteless, odorless, non-toxic, non-contaminating and non-absorbent. Withstands temperatures from −110° to 500° F.

LOWER COST. Garlock now offers you cementable Teflon in thicknesses as thin as .005" for inexpensive application wherever its non-sticking, chemical resistant qualities are desired. Available in rolls ½" to 12" wide; .005" to .060" thicknesses. Also available in sheets up to 48" x 48", in thicknesses of 1/16" to 1".

Sheets and Tape of Cementable Teflon are another important part of "the Garlock 2,000" . . . two thousand different styles of gaskets, packings, and seals to meet all your needs. It's the only complete line. It's one reason you get *unbiased* recommendations from your Garlock representative. Call him, or write for Bulletin AD 158.

THE GARLOCK PACKING COMPANY, Palmyra, New York

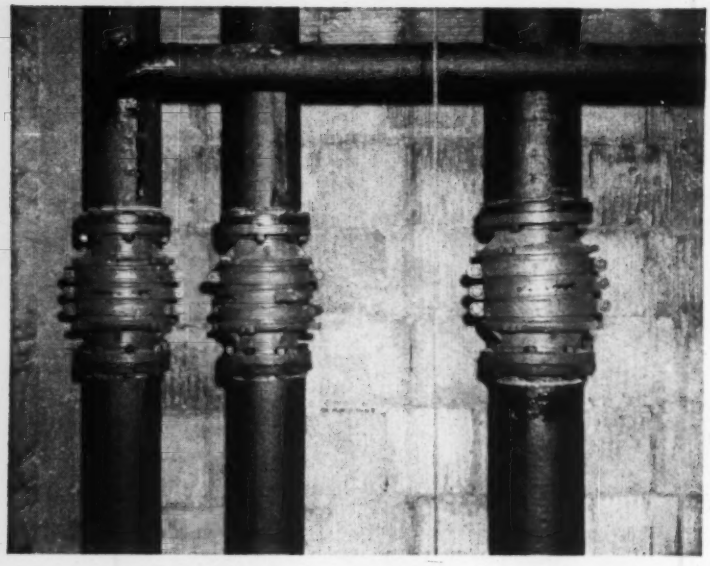
For Prompt Service, *contact one of our 30 sales offices and warehouses throughout the U. S and Canada.*

* *DuPont Registered Trade-Mark*

GARLOCK

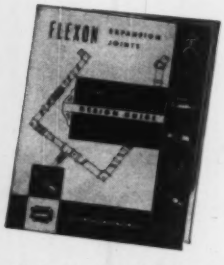
Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints

Expansion, Misalignment Problems Solved with Flexon Expansion Joints in Heating—Air Conditioning Piping



FLEXONICS
A Single Source for Every Expansion Joint Requirement

Flexonics Corporation manufactures a complete line of expansion joints in free-flexing, controlled-flexing and special types. Sizes range from 3" up.



Ask for your copy of the Flexon Expansion Joint Design Guide. It provides application and installation data for a wide range of services.

The Flexon Expansion Joints illustrated above are protecting the new heating and air conditioning piping just installed for the Engineering Building, Chicago, Illinois.

During the winter months, the risers shown carry hot water for heating this modern 23 story office building. When summer comes, this same system is utilized for the circulation of chilled water for air conditioning.

These Flexon Expansion Joints are designed for the double duty they perform here and will handle axial movement up to 3". They are rated for pressures to 150 psi and temperatures to 500° F. They also compensate for misalignment in piping.

Flexon Expansion Joints can protect your piping from the dangerous stresses of thermal motion and misalignment which could eventually result in piping failure.

They are manufactured by pioneers in the fabrication of corrugated metal assemblies with over 54 years of experience. For routine or unusual applications, play it safe, specify Flexon Expansion Joints.

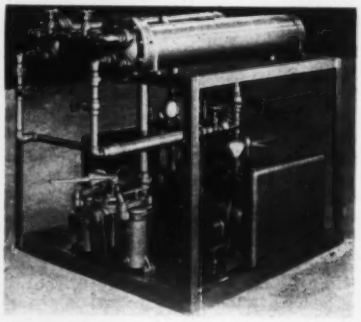
SEE US AT THE POWER SHOW — BOOTH 346

EJ2(

FLEXON® QUALITY
proved in service and backed by over 54 years manufacturing experience

Flexonics *Corporation*
EXPANSION JOINT DIVISION
1305 S. THIRD AVENUE, MAYWOOD, ILLINOIS
FORMERLY CHICAGO METAL HOSE CORPORATION
Manufacturers of flexible metal hose and conduit, expansion joints, metallic bellows and assemblies of these components.
In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS



Heater-Pump Sets

Packaged combinations for preheating, straining and pumping heavy No. 5, No. 6 and Bunker C fuel oils are available in duplex or single assemblies from York-Shipley, Inc., York, Pa. Each set is a completely self-contained unit, ready for immediate operation as soon as connections are made to the fuel line and electrical service.

Manufactured for use with all burners designed to burn heavy oil, these pump and preheater assemblies come in four standard sizes: Model 100, pump size 2C, 100 gph; motor 1/2 hp; Model 225, pump size 3C, 225 gph; motor 3/4 hp; Model 400, pump size 4C, 400 gph; motor 1 hp; Model 700, pump size 5C, 700 gph; $1^1/_2$ hp.

Equipment for single assemblies includes oil preheater, duplex oil strainer, fuel pump, motor, pushbutton magnetic starter, pressure gage reading from 0 to 160 psi, $^3/_4$-in. relief valve, sheaves and belts, fan-type temperature gage, check valve and gate valve. These components are assembled and mounted on a steel base plate and frame. Aquastat and circulator for hot water or steam solenoid for steam are also furnished, but not mounted.

For duplex assemblies, two sets of most of the components listed above are provided.

Label Dispenser

Production of a new, improved automatic dispenser for pressure sensitive labels is announced by Archer Label Co., 783 Kohler St., Los Angeles 21, Calif. The new dispenser, Multimatic Model 5, is said to speed up label application as much as 400 per cent over manual methods.

The new model has a heavier motor and overall construction has been simplified to permit the use of fewer parts. The trip mechanism has been made sturdier and more simple, the firm states, and loading has been made easier and quicker. The heating unit is larger to take care of the increased width of the machine.

The new unit will dispense multiple rows. A multiple width roll as wide as $5^3/_4$ in. will contain from 1000 to 10,000 labels. From two to eight or ten labels can be dispensed at once, depending on the size of labels.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

10-Ton Fork Truck

A new electric-powered, stand-up, center control fork truck, with a capacity of 10,000 lb, has been announced by Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 3, Ohio.

The new model, designated as RIOT, features front wheel drive, rear wheel steer, and has a travel speed of 4.5 mph without load, 4 mph with a full load.

Other features of the truck include contactor control with automatic acceleration; four speeds forward and reverse. Direction and acceleration are through a single hand control lever. The frame is of heavy gage reinforced formed steel plates electrically welded into a rigid box structure.

Automatic Loader

A unique new Red Ring fully automatic loading device for handling spur or helical internal gears on shaving machines has been developed and put on the market by National Broach & Machine Co., 5600 St. Jean Ave., Detroit 13, Mich.

The loader is said to solve the problem of meshing the teeth in an internal gear with those of the helical gear-shaped shaving cutter. An intermediate air-powered loading sleeve mechanism which receives the internal gears one-at-a-time from a magazine feed, hangs them on the cutter and provides the meshing problem solution. The loader can be installed on the company's Model GCR internal shaving machines.

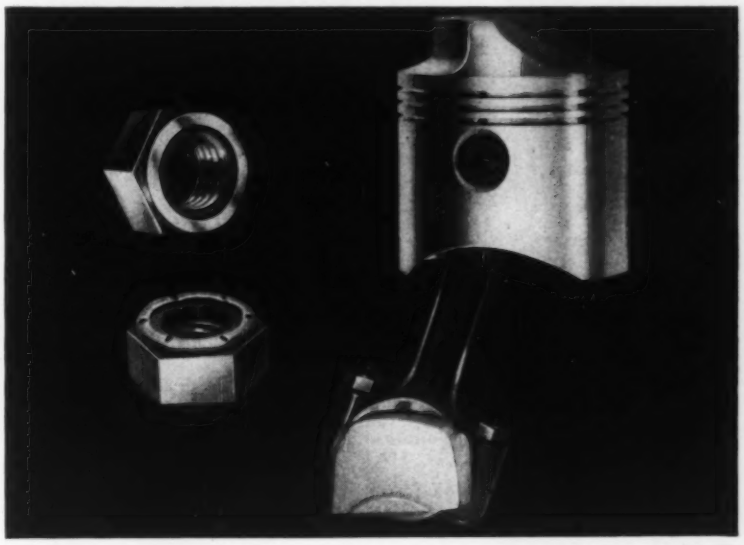
Internal gears to be shaved are loaded in a magazine where they roll by gravity to a position in front of an air-powered plunger. The plunger pushes one gear at a time into the loading sleeve, which is mounted on a swinging arm and swung through an arc by an air cylinder-controlled linkage.

The pushing of an unshaved gear into the sleeve at this raised position causes a finish-shaved gear in the other end to be deposited in an unloading magazine where the shaved gears roll to a location at the front of the machine.

In the next loader sequence, the sleeve holding the unshaved gear is swung downward by the air cylinder into line with the work spindle centerline. A finish-shaved gear in the chuck on the work head is ejected by another air cylinder into the sleeve. Entry of the finish shaved gear ejects the unshaved gear in the other end of the sleeve into mesh with the shaving cutter where it remains hanging on the cutter.

Then the loading sleeve is raised back to the load position. The internal gear and shaving cutter are advanced as a unit toward the chuck in the workhead and the gear is chucked, ready for the shaving operation with the cutter in mesh with the gear. At the end of the shaving operation, the cutter spindle is backed out of the gear and returned to its original position for the loading of another unshaved gear.

FASTENER PROBLEM



New high strength fastener for applications with minimum wrench clearance

A special fastener approximately 20% stronger than a standard ¼-28 hex nut, yet compact enough to permit wrenching within limited clearances, was required for the connecting rod cap bolts on the Kiekhaefer Corporation's high powered new line of "Mercury" outboard motors. It had to withstand the dynamic forces normal to small internal combustion engines.

The new Type TEE2032 heat treated steel, washer-faced hex nut is ESNA's answer to this problem. Its height is decreased to .239 and its width across the flats is reduced to .375. With the over-all dimensions of the ¼-28 Thread Type TEE2032 reduced to those of a 10-32 nut, it is still capable of axial tensile performance rated at 5,379 pounds minimum. The washer face is manufactured to precise seat squareness specifications.

Absolute security against any loosening of the vital connecting rod fastening by vibration is provided by the red nylon locking insert which permits accurate bolt stressing and assures extended reusability. The insert is unaffected by engine oils and crank case temperatures. Type TEE2032 is a typical example of ESNA's ability to come up with a solution to special fastening problems. Why not give us an opportunity to recommend a solution to yours?

MAIL COUPON FOR DESIGN INFORMATION

ESNA

Dept. N16-1011, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send me the following free fastening information:

☐ Standard drawing of Type TEE2032 washer face hex nut.

☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name_____ Title_____

Firm_____

Street_____

City_____ Zone____ State_____

PRODUCTION HANDBOOK

Instant Answers to Hundreds of Manufacturing Questions

THE BEST experience of modern industrial firms—to help you plan, organize, engineer, and control production processes in any type industry, any size operation. Packed with today's advanced manufacturing techniques. 26 Sections cover: Plant Organization; Quality Control; Layout; Maintenance; Factory Budgets; Production Planning and Control; Machinery; Jigs and Fixtures; Etc. 90 Contributing, Consulting Editors. *771 ills., 1676 pp.* $12

Other RONALD Handbooks:

Accountants' Handbook, *4th Ed.*	$15
Cost Accountants' Handbook	12
Financial Handbook, *3rd Ed., Revised Printing*	12
Forestry Handbook	15
Marketing Handbook	12
Personnel Handbook	12

● *Through bookstores or write to:*

THE RONALD PRESS COMPANY
15 East 26th Street, New York 10

NATIONAL AIROIL FUEL OIL · GAS BURNERS

SERVING INDUSTRY FOR 44 YEARS

- Steam Atomizing Oil Burners
- Mechanical Atomizing Oil Burners
- Low Air Pressure Oil Burners
- Rotary Oil Burners
- Industrial Gas Burners
- Combination Gas and Oil Burners
- Tandem Block Combustion Units
- Fuel Oil Pump Sets
- Refractory Burner and Muffle Blocks
- Valves, Strainers, Furnace Windows

Detailed information gladly sent you upon request on your business letterhead, please.

Established 1912 — Incorporated 1917

NATIONAL AIROIL BURNER COMPANY, INC.
1239 East Sedgley Ave., Philadelphia 34, Pa.
S. W. Division: 2512 So. Blvd., Houston 6, Texas

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Centrifugal Clutch

A new clutch especially small and compact has been introduced for motors requiring high torque starting by the E-Z Machine and Tool Wks., Beloit, Wis.

Called the "Power Taper" centrifugal clutch, it features two types of self-energizing power. It self-energizes in the normal centrifugal method and also in an angle direction because of a tapered pin on which the shoes rest, the firm states.

As the shoe moves out with centrifugal force, the power taper pin forces the shoe tighter against the drum thru lever action. Thus, two types of force are involved, centrifugal and lever. In addition to the small size, the clutch features more accurately predetermined engaging speeds due to the shoes being anchored to each other with springs, the company explains. Both shoes move out with centrifugal force equally and engage simultaneously with the same effort on the drum walls. The strength of the springs may be varied to provide different engaging speeds.

The company says another advantage of the clutch is the lack of a rigid anchor of the shoes. This allows the shoes to float in all directions 4 deg permitting automatic adjustment for any misalignment in shafts when used as a clutch coupling.

The clutch is adaptable to lawnmowers, chain saws, air conditioners and like equipment.

Stabilizing Units

Production stabilizing units developed by Gear-O-Mation Div., Michigan Tool Co., 17140 E. Ten Mile Rd., East Detroit, Mich. are now available from the company.

The units, which become an integral part of an automated line, receive a floating and continuously moving bank of parts from the machine ahead and feed the parts as needed into the following machine. They consist essentially of zig-zag gravity feed tracks and parts elevators. The firm says the units can be used to insure continuity of production of any round part such as gears or screw machine blanks.

Design is such that the number of parts in the floating bank may be anywhere from several hundred to more than 5000. In general, the company explains the bank size is selected to provide temporary storage and releasing of a number of parts, the processing of which corresponds to the maximum time required to make tool changes on the machine ahead or following of the unit.

In case of breakdown of one machine, the tower which feeds the machine merely adds parts produced by the preceding machine to those in its floating bank. At the same time, the unit beyond the machine releases parts previously stored in its floating bank to the next machine.

The firm says that under normal conditions, the units can be used to level out the operation of all machines in an integrated

ENGINEERS

AC *needs*

SERVO ENGINEERS

... Electrical

... Mechanical

GM INERTIAL GUIDANCE SYSTEM PROGRAM

ELECTRONICS DIV.,
Milwaukee 2, Wis.

●

Seeks experienced engineers for the further development and systems testing of Inertial Guidance Systems and their Servo Loops.

Enjoy Challenging Opportunities in the most versatile Laboratories in the country. Work with the top men in the field and with the finest test, research and development facilities. We are in the process of a Major, Permanent, Expansion Program. New Plant facilities being added in suburban Milwaukee area.

To aid you in your professional advancement AC will provide financial assistance toward your Master's degree. A Graduate Program is available evenings at the University of Wisconsin, Milwaukee.

GM's Electronics Division aggressive position in the field of manufacture and GM's long-standing policy of decentralization creates individual opportunity and recognition for each Engineer hired.

Recent EE,ME Graduate Inquiries Also Invited

Milwaukee offers ideal family living in a progressive neighborly community in cool, southern Wisconsin where swimming, boating, big league baseball and every shopping and cultural advantage is yours for the taking.

To arrange personal, confidential interview in your locality send full facts about yourself today to

Mr. John F. Heffinger
Supervisor of Salaried Personnel

AC Electronics Div.
General Motors Corp.
Milwaukee 2, Wis.

ENGINEERS
Mechanical & Electromechanical

APL-An Organization Of And For Technical Men And Scientists

The Applied Physics Laboratory, (APL) of the Johns Hopkins University is an organization of and for technical men and scientists. APL is organized on a horizontal *basis*; responsibility and authority are given in equal measure. Scientists and technical men occupy all decision-making positions, because our *only* objective is technical progress.

Because of its predominantly professional character, APL has kept in the vanguard, having pioneered the proximity fuze, the first supersonic ramjet engine, the Navy's Bumblebee family of missiles which includes the TERRIER, TALOS and TARTAR, and is presently attempting break-throughs on several important fronts.

Occupying a site equidistant from Washington, D. C., and Baltimore, Maryland, APL's new laboratories allow staff members to select urban, suburban or rural living, and either of these outstanding centers of culture as a focal point for fine living. Salaries compare favorably with those of other R & D organizations.

OPENINGS EXIST IN:

DESIGN: Airframes and structures; hydraulic and power supply systems; servomechanisms; launching and handling equipment; ramjet engines.

ANALYSIS: Stress; weights and loads; heat transfer; dynamics; warheads.

Write for complete information. Your letter will be answered personally, in detail.

To: Professional Staff Appointments

The Johns Hopkins University Applied Physics Laboratory

8607 Georgia Avenue, Silver Spring, Md.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

manufacturing line. Individual machines can be operated at their maximum efficiencies for planned production periods without being limited by what the machine ahead or behind has turned out. The company points out, for example, that one machine with a high output rate could be operated on a one shift basis while the machine directly ahead or behind it has a longer machining cycle, could be operated on a two shift basis. Similarly, a certain machine could be operated for portions of one shift while others in the line were run full time.

Grommet Seal

A grommet seal has been introduced by Cartriseal Corp., 3515 Touhy Ave., Lincolnwood, Ill. The new seal, identified as the 4000 Series, has been designed especially for liquid pumps and freon compressors.

It is said to permit replacement of defective packing-type seals without changing the worn shaft. The firm says close hydraulic balance permits the liquid pressure. The seal is available in six standard sizes adjustable to any length with broad axial tolerances. Metal components and mating face materials may be varied to suit all conditions, including liquids containing grit or other abrasive particles, the firm states.

Cup Testing Machine

Testing the ductility of very thin metals is the function of a new cup tester developed by Steel City Testing Machines, Inc., 8817 Lyndon Ave., Detroit 38, Mich.

Designed specifically for testing thicknesses from .003 to .062 in. the new machine can be used for testing many different types of metals including copper, brass, aluminum, tin plate, stainless steel, and carbon steel.

The cup tester, designated Model D, is a bench-mounted hydraulically operated unit. Power is supplied by a $^1/_6$ hp motor mounted on the rear of the base which incorporates the tank of hydraulic oil. The firm says two simple valves on the front of the base provide infinite control of the testing operation. Depth of cup is shown by a dial indicator which is fitted with a friction brake so that maximum deflection readings are retained until released by the operator. Maximum load at time of yield is shown by red "lazy" hand on load gage.

The ball penetrator is a standard $^7/_8$ in. diam and the die supplied with the machine is a standard 1 in. diam. The firm says that while the minimum width for use with a $^7/_8$ in. penetrator is recommended to be 2 in., narrower strip can be tested by using special small-diameter penetrators. Such special penetrators, with matching dies and clamping plates, are available with the unit at slight extra cost.

Overall size of the new tester is $11^1/_2 \times 21 \times 25$ in. high. Net weight is less than 200 lb. Complete specifications are shown on a descriptive catalog sheet available from the company.

How To Get Things Done Better And Faster

BOARDMASTER VISUAL CONTROL

☆ Gives Graphic Picture—Saves Time, Saves Money, Prevents Errors
☆ Simple to operate — Type or Write on Cards, Snap in Grooves
☆ Ideal for Production, Traffic, Inventory, Scheduling, Sales, Etc.
☆ Made of Metal Compact and Attractive. Over 100,000 in Use

Full Price $49.50 with cards

FREE 24-PAGE BOOKLET NO. 20-R Without Obligation

Write for Your Copy Today

GRAPHIC SYSTEMS

55 West 42nd Street • New York 36, N. Y.

Licked by a lightweight?

Being knocked out by a pint-sized competitor?
Maybe they are already using **MPB's** ✳
such as these

BALL BEARINGS ACTUAL SIZE

A postcard will bring you complete data on 500 types and sizes.
Lead with your left, and write!

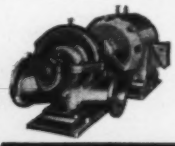
✳**MINIATURE PRECISION BEARINGS, INC.**
23 Precision Park, Keene, N. H.

Please send MPB's new Catalog to:

Name.....Title.....
Company.....
Street.....
City.....Zone.....State.....

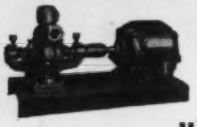
Superb Performers

AURORA APCO *Turbine-Type*



AURORA *Always* PUMPS

AURORA® *Centrifugal*



for EVERY LIQUIDS HANDLING JOB in INDUSTRY

ASK for CONDENSED CATALOG M-9

The engineer-favor accorded "PUMPS by Aurora" rests squarely upon performance satisfaction. Why not let Aurora precision and quality serve your requirements, too?

AURORA APCO *Turbine-Type* PUMPS

are available in SINGLE STAGE • TWO STAGE • FOUR STAGE • WATER JACKETED • STAINLESS STEEL or SPECIAL METALS for "1001" DUTIES.

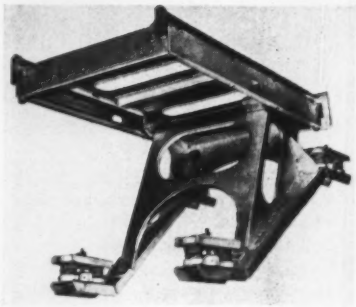
AURORA *Centrifugal* PUMPS

are available in SINGLE and TWO STAGE HORIZONTALLY SPLIT CASE • SIDE SUCTION • VERTICAL • NON CLOG • SUMP • MIXED FLOW • SPECIAL DESIGN ETC.

DISTRIBUTORS IN PRINCIPAL CITIES

AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY
96 LOUCKS STREET • AURORA • ILLINOIS
INTERNATIONAL SALES OFFICE, 90 WEST ST., NEW YORK 6, N. Y.

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS



Vibration Mounting

An engineered mounting system, designed and manufactured by Robinson Aviation, Inc., Teterboro, N. J., is announced for equipment protection against shock and vibration in jet or conventional aircraft.

According to the company, electronic equipment and delicate mechanical components are easily mounted with minor design modifications, and vibration isolation is more than 90 per cent at frequencies of 30 cycles per second and higher.

Advanced design application of the principles of the center of gravity type of suspension system positions the resilient members so that they and the equipment center of gravity are in approximately the same diagonal plane. This arrangement, the company says, assures maximum stability for the mounted equipment by virtually eliminating rocking and tipping modes.

Model 1374-3 is designed to support a radar indicator and scope weighing 37 lb, but may be modified for various loads by the firm's engineers. The company says cameras, navigational gear, instruments, antennas, electronic fire control units and such airborne equipment is assured of positive protection with the firm's resilient cushions regardless of exposure to sunlight, oil, ozone, dust, water, temperature extremes and length of service.

The rack and pinion device with locking handles facilitates easy alignment of equipment by the operator while in flight. All adjustments may be made for horizontal tilting and longitudinal traverse of the equipment, manually.

Shorted Turns Indicator

A unique new shorted turns indicator, designed to test coils for shorts and open circuits in one fast simple operation before assembly, is announced by B&K Mfg. Co., 3731 N. Southport Ave., Chicago 13, Ill.

The firm says the Model M-1 gives positive indication for production testing, incoming inspection and laboratory use by finding shorts and open circuits before the coil is mounted onto a relay, transformer, or other device.

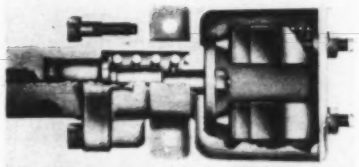
In operation, the coil is placed over the test rod and the meter indicates whether the coil is good or bad. The company states that

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

adjustable sensitivity provides selective testing and allows production engineers to set standards that permit passing or rejecting coils with any particular number of shorted turns.

A vacuum tube voltmeter is also provided as an indicating device. Sensitivity of the meter section is controlled by the balance control. The unit has been designed so that there is no shock hazard to the operator. Safeguards against overload and meter burn-out are built-in. Induced current is small at high frequency and of high impedance source nature. Test rod is protected by a plastic sleeve. Maximum sensitivity obtainable is determined by the inside diameter or "window" area of the coil. Special test rods are available for testing coils of unusual size and shape.



Piston Pressure Switch

A new pressure switch, 9622 or C9622, capable of sensing two different pressures in one system and actuating independent electrical circuits at any two desired points, is announced by Barksdale Valves, Pressure Switch Div., 5125 Alcoa Ave., Los Angeles 58, Calif.

The units may be used to maintain a pressure where it is imperative that the system pressure does not exceed or fall below predetermined values. They accurately sense any system pressure over an adjustable range of 15 to 3000 psi for proof pressures from 3000 to 7000 psi, depending on the switch setting.

The switch incorporates two UL-approved spdt snap action switching elements rated for a-c and d-c circuits. Each switching element is electrically independent of the other.

The piston type sensing element of this switch can be expected to perform millions of cycles under fast, continuous operation, the company claims, adding that it is not sensitive to jarring of vibration.

Pressure settings are made by two external adjustment screws which can be locked in place to avoid accidental disturbance. The switch comes with an exceptionally adaptable mounting bracket which may be rotated to any position on a full circle or moved up and down on the neck of the switch.

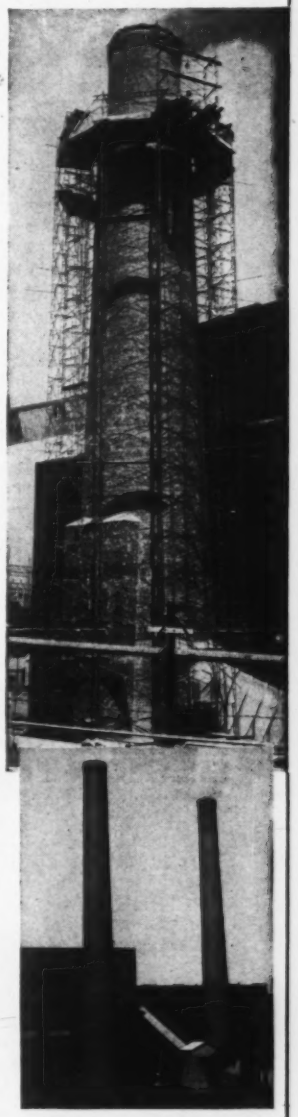
Model C9622 has two calibrated dials which enable the user visually to set either switch, without gages, before or after installation on a pressure line.

CONSOLIDATED builds
a Chimney around an Operating Chimney!

A large Eastern utility greatly expanded the generating capacity of one of its important stations and needed two new 250 ft. x 13 ft. inside top diameter radial brick chimneys for the new and larger boilers. At the same time it was necessary to keep the old boilers operating with their existing 150 ft. chimney.

Consolidated engineers and construction crew met the situation by erecting one of the new 250 ft. chimneys and building the greater portion of the second around the older operating chimney. The original chimney continued in operation until the new chimney was erected to the same height; then the top 100 ft. was completed in a 7 day shut down period!

This is just one more example of Consolidated's engineering skill and adaptability to the requirements of the job and the service required. Many hundreds of Consolidated Chimneys have been designed and built for leading companies and larger contractors throughout the United States, in Canada and in Mexico. Designed by men who know their business, erected with painstaking care and skill to exact specifications, Consolidated Chimneys give performance and service year in and year out to meet the most exacting requirements.



Upper photo shows the building of the new 250 ft. radial brick chimney around the existing 150 ft. chimney. Note outside tubular pipe scaffolding. The original chimney continued in operation until the new chimney was erected to the same height as the existing one. Then the top 100 ft. was completed in a 7-day shut down period.

Lower photo shows the two completed Consolidated chimneys in operation. The chimney at right is one built around the old chimney; chimney at left was erected at the same time. Both chimneys are of radial brick construction 250 ft. x 13 ft. inside top diameter.

Consolidated designs and builds chimneys of all types and all sizes—Perforated Radial Brick, Tapering Reinforced Concrete, Face and Common Brick, Acid Proof, High Temperature; installs linings for steel stacks, waterproofs, repairs and rebuilds, installs lightning rods and aircraft warnings; demolishes chimneys. Whatever your chimney problem may be, Consolidated has the experience, the knowledge and the skilled personnel to handle it.

Phone, wire or write today *for information. Ask for catalog giving installations, engineering service, chimney design data and specifications.*

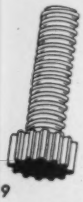
CONSOLIDATED CHIMNEY COMPANY
Engineers and Builders
6 South Dearborn Street, Chicago 3 • Telephone RAndolph 6-6223
New York, N. Y., 545 Fifth Avenue • Telephone Murray Hill 7-6867
Detroit, Cleveland, Minneapolis, Richmond, Va.

LOW COST
ACME NUTS
& TAPPED PARTS
H&R
The Threading Specialists

Specialists in Acme tapped parts for 21 years, H & R offers top quality, prompt delivery at substantial savings:

★ SPECIALIZED TOOLING cuts production costs, gives you finer finishes, closer tolerances.

★ LOWER TOOLING COST— usually "off the shelf" at H&R!



Get the facts about H & R Acme threaded parts now. Send sketch or drawing — let us show you what we can do to cut your costs!

19

HORSPOOL & ROMINE
MANUFACTURING CO., INC.
5850 MARSHALL ST., OAKLAND 8
TELEPHONE OLYMPIC 2-1844

DESIGNERS

WHAT major organization offers continual original work assignments?

For the answer turn to page 169

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Precision Boring Machine

A six-station trunnion-type, two-way precision boring machine that performs both machining and automatic assembly operations has been designed and built by Snyder Tool & Engineering Co., 3400 E. Lafayette, Detroit 7, Mich.

The machine which has six precision boring spindles, utilizes a rotary hopper feed to direct split babbitt bushings to a plunger for press-fit assembly into the part at the fourth station. Deflection of the part during assembly operation is prevented by a hydraulic stop that advances to within 0.002-in. of the back face of the part.

According to the company, the unit machines $5^{11}/_{16}$-in. diam die-cast electric motor end shields and assembles a bushing in the center hole at a production rate of 350 pieces per hour at 75 per cent efficiency. An end shield is manually loaded into one of the fixtures in the horizontal trunnion index fixture, chucked and a pushbutton operated to index the fixture and initiate the machining cycle.

In the second station, precision boring spindles in each way unit advance to turn a groove on the outer lh hub, rough face the lh hub and rough bore, rough face and chamfer the rh hub. At station three, a $^{5}/_{8}$-in. hole is bored in the hub and chamfered, the OD is turned, and a step on the OD is faced with tools in a single heavy-duty precision boring head.

The brushing is assembled in station four. In station five, two precision boring spindles face both ends of the hub and bushing. The lh side of the pressed-in bushing is chamfered in station six with a precision boring spindle.

All machining operations occur simultaneously with parts in the five machining stations. At each index, a part is unloaded from station one and another part loaded in and chucked before the cycle start button is pressed. The machining cycle on the hydraulically operated, electrically controlled machine is entirely automatic.

The new machine occupies a floor space about 8 by 14 ft and is 8 ft high overall. Air-oil mist lubrication is provided for the precision boring spindles wich are motor driven through V-belt drives. Indicator lights on the control panel indicate the operating condition of each machining function.

Selenium Rectifier

Type 60-7788, a small compact plug-in selenium rectifier especially designed to replace the 6AL5 tube in many TV sync discriminator circuits, is announced by International Rectifier Corp., El Segundo, Calif.

These subminiature rectifiers are much smaller in size and also do not require any heater power, the firm states.

The unit consists of two 1U1 selenium diodes, mounted and soldered to a plug that

SAFETY IS FIRST WITH TRI-LOK!

Replace your slippery, rickety old wooden floors with the safest flooring available . . . *Tri-Lok* and *Tri-Forged* Grating. Here are some outstanding features: long life, unusual strength, adaptability, handling ease, minimum weight, maximum openings for light and ventilation. *Tri-Lok* and *Tri-Forged* products meet government specifications, are available in a wide range of panel sizes.

Department D—1210
DRAVO
CORPORATION
Pittsburgh 22, Penna.
National Distributors

...before it TALKS

...is the way our doctors put it—"Our chances of curing cancer are so much better when we have an opportunity to detect it *before it talks.*"

That's why we urge you to have periodic health check-ups that *always* include a thorough examination of the skin, mouth, lungs and rectum and, in women, the breasts and generative tract. Very often doctors can detect cancer in these areas long before the patient has noticed any symptoms.

For more life-saving facts phone the American Cancer Society office nearest you, or write to "Cancer"—in care of your local Post Office.

American Cancer Society

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

fits a seven pin miniature tube socket. Each diode is designed to deliver 20 v d-c at 1.5 ma for an rms voltage input of 26 v max and may be operated through an ambient temperature range of minus 50 C to 100 C. The diodes are completely encapsulated within a thermosetting plastic to protect them from moisture, corrosive atmosphere and fungi.

In addition to their application as horizontal sync phase discriminators in television receivers, the diodes are ideal components for bias supplies, power supplies for sensitive relays, in computors and in many other circuits, the company says.

BUSINESS NOTES

Sales Representative

Rittelmeyer & Company, Inc. has been appointed sales representative for Hills-McCanna chemical metering and proportioning pumps and force feed lubricators in Georgia and eastern Tennessee. The new representative is located at 150 Nassau St., N. W., Atlanta 1, Ga.

To Distribute Computer

Librascope, Inc., Commercial Div., Burbank, Calif., announces that Barton Instrument Corp. of Los Angeles will distribute the new Librascope flow computer line.

The flow computers are pressure compensated totalizing devices for orifice measurements of fluids. The computer is claimed to reduce or completely eliminate hand integration of chart records, providing great accuracy and remote control transmission.

Representatives Named

Marind, Industrial Products Div. of Maryland Shipbuilding and Drydock Co., Baltimore, Md. has announced the appointment of representatives in the following principal cities: Detroit, Mich., Bradbury-Kenrick Associates; Portland, Ore., Charles E. Klaus Co.; Pasadena, Calif., Dave B. Cole; Chicago, Ill., Piepenbrink Engineering Co.; York, Pa., J. L. Souser & Associates; Cleveland, Ohio, Wagner-Green Co.; Cincinnati, Ohio, Hare Equipment Co.; Atlanta, Ga., Miami, Fla., Birmingham, Ala., Sumter, S. C., The Gearhart Co.; Houston, Tex., Howell Engineering Corp.; Kansas City, Mo., Midwestern Power Equipment Co.; St. Paul, Minn., Northwestern Power Equipment Co.; Santurce, Puerto Rico, Ramon I. Gil.

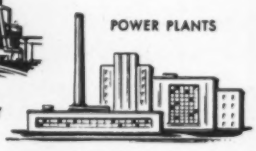
The firm has facilities for the design, manufacture and installation of condensers, feedwater heaters, deaerators, make up evaporators, special heat exchangers and associated equipment for central station and industrial power plants.

Industry looks to

RESEARCH -COTTRELL

for high dust collection efficiencies

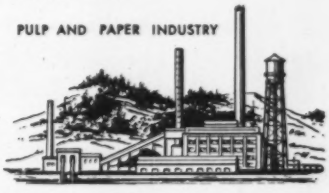
CHEMICAL PROCESS AND STEEL INDUSTRY



POWER PLANTS

To maintain visually clean stacks at all times, industry is turning to the long experience of Research-Cottrell in the design and manufacture of highly efficient Cottrell Electrical Precipitators. We've spent 40 years in solving such problems as nuisance abatement, cleaning gas for subsequent use and recovering materials of value. Write for illustrated bulletin describing a wide range of electrical precipitator applications.

PULP AND PAPER INDUSTRY



RESEARCH-COTTRELL, INC.

A WHOLLY OWNED SUBSIDIARY OF RESEARCH CORPORATION

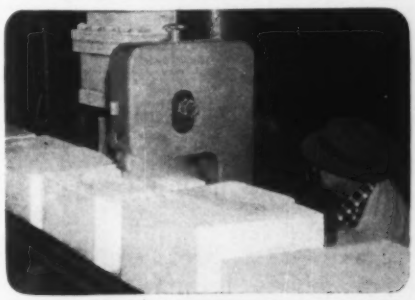
Main Office and Plant: Bound Brook, N. J.

405 Lexington Ave., New York 17, N. Y. • Grant Building, Pittsburgh 19, Pa.

AC 137 *228 N. La Salle St., Chicago 1, Ill. • 111 Sutter St., San Francisco 4, Cal.*

FRICK

Compressors Make Dry Ice With New Economy



The Colorado CO_2 Corp. produces up to 50 tons of solid carbon dioxide daily in its $2½-million plant near Las Animas, Colo.

The gas, obtained from wells 5 miles away, is condensed, subcooled, and solidified at 109 degrees below zero F. with a new Frick-engineered cycle operating at very economical pressures.

Practically all the mechanical equipment in the plant was furnished and installed by Frick Company. Another example of the COMPLETE engineering service that is yours when you purchase Frick air conditioning, ice making, quick freezing or other refrigerating equipment. Let us quote you now on your requirements.

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA. U.S.A.

Frick Equipment at Colorado CO_2 Corp.

When product designs for welded steel

Have twice the rigidity... three times the strength

Yet require less material ...cost less to fabricate

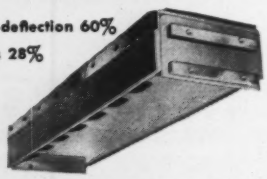
WHY

aren't all your products designed for welding?

THE WELDED WAY

...cuts deflection 60%

...costs 28% less



Welded steel square shear bed for Famco Machine Company, Kenosha, Wisconsin, is more accurate because it's more rigid.

Have Lincoln help you duplicate these benefits now.

Write

THE LINCOLN ELECTRIC CO.

Dept. 4811 • Cleveland 17, Ohio

The World's Largest Manufacturer of Arc Welding Equipment

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Canadian Plant Announced

Ric-wiL, Inc. supplier of prefabricated insulated piping systems, announces that an affiliate, Ric-wiL Company of Canada Ltd., has set up manufacturing facilities in St. Thomas, Ontario.

Distributor Named

Home Equipment Distributing Co., 135 38th St., N. E., Cedar Rapids, Ia, has been appointed distributor of Dravo heating equipment in the Iowa counties of Benton, Linn, Iowa, and Johnson. Dravo Corp., Pittsburgh, Pa., is a manufacturer of industrial and commercial warm air space heating and process drying equipment.

LATEST CATALOGS

Coagulator, Settler

Hungerford & Terry, Clayton, N. J., announces bulletin G-11, describing its Coagulator, a high speed up-flow solids contact type coagulation and settling unit in wide use for water clarification, water softening and waste treatment.

The unit is built of concrete, steel or wood, square or round and both with and without sludge scraper type of bottom.

Magnetic Welders

Precision Welder and Flexopress Corp., Cincinnati, Ohio, has published a six-page bulletin covering its magnetic force welders.

The bulletin points out the advantages of magnetic force welding to join difficult-to-weld critical materials. Also light initial electrode pressure permits projection welding on materials whose projections would collapse under conventional electrode pressure, the firm states. The bulletin is designated MF-100.

Convection Heat

A new technical paper, "Effect of Convection Heat in Radiant Sections of Tubular Process Heaters," by L. A. Mekler, has been published by Petro-Chem Development Co., 122 E. 42nd St., New York 17, N. Y. Mekler is a consulting engineer who has 40 years of experience in the design, development and operation of equipment for applying heat to thermochemical and thermophysical processes. He has over 80 patents and has published about 50 papers in this field.

The paper, 12 printed pages in length, including charts and diagrams, discusses the heat input by convection heat that is superimposed on the radiant rates of tubular process heaters by the main stream of fresh combustion products flowing through the heater, or by the stream of gases recirculated within the radiant section of the heater.

ENGINEERS

...Electrical

...Mechanical

CHALLENGING OPPORTUNITIES
To men with a degree and an interest in

GYRO ASSEMBLY and TEST

Engineers who have a personal interest in precision mechanisms, where a high degree of accuracy is required . . . men with pride in the precision of the product they help build.

You will constantly be doing development work and testing in one of the most versatile Laboratories in the country...working with the top men in the field and with the finest test, research and development facilities. We are in the process of a Major, Permanent, Expansion Program. New plant facilities being added in suburban Milwaukee area.

To aid you in your professional advancement AC will provide financial assistance toward your Master's degree. A Graduate Program is available evenings at the University of Wisconsin, Milwaukee.

GM's Electronics Division aggressive position in the field of manufacture and GM's long-standing policy of decentralization creates individual opportunity and recognition for each Engineer hired.

Recent EE,ME Graduate Inquiries Also Invited

•

Milwaukee offers ideal family living in a progressive neighborly community in cool, southern Wisconsin where swimming, boating, big league baseball and every shopping and cultural advantage is yours for the taking.

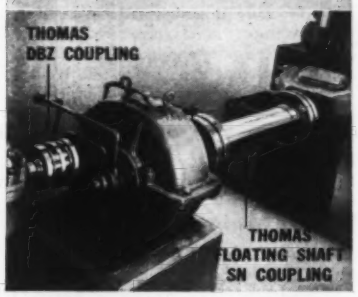
To arrange personal, confidential interview in your locality send full facts about yourself today to

•

Mr. John F. Heffinger
Supervisor of Salaried Personnel

AC Electronics Div.
General Motors Corp.
Milwaukee 2, Wis.

Freedom From Coupling Maintenance



Install Thomas Flexible Couplings

First cost is *only* cost when you buy Thomas Flexible Couplings . . . because Thomas Flexible Couplings are correctly engineered . . . have no wearing parts . . . need no lubrication . . . eliminate future maintenance costs. Even more, Thomas all-metal couplings are open for inspection while running—ending inspection shut-downs!

For all practical purposes, properly installed and operated within rated conditions, Thomas Flexible Couplings will last forever.

NO LUBRICATION . . .
NO MAINTENANCE . . .
There Are No Wearing Parts

Under load and misalignment, only Thomas Flexible Couplings offer all these advantages:

1. Freedom from backlash—torsional rigidity
2. Free end float
3. Smooth, continuous drive with constant rotational velocity
4. Visual inspection while operating
5. Original balance for life

Write for Engineering Catalog 51A

THOMAS
FLEXIBLE COUPLING CO.
WARREN, PA.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Lubrication Sprays

An eight-page brochure, Bulletin No. 60-A, [illegible] for open gearing and slide surfaces is available from Farval Corp., 3249 E. 80th St., Cleveland 4, Ohio.

The three-color, illustrated booklet offers descriptions of manual and automatic systems and component equipment with schematic layouts and actual application views.

Remote Metering System

A bulletin describing features, applications, future expansion provisions of simple remote metering system with "plug in" construction is available from Sparton Control Systems Div., Jackson, Mich.

The system employs transducers and electronic bridge circuit, with overall accuracy said to be better than 2 per cent.

Soldering To Silver

A two-page technical bulletin on silver bearing soft solders is now available from Alpha Metals, Inc., 56 Water St., Jersey City, N. J. Included is a discussion on silver scavenging, alloy selection, applications and available alloys.

A graph, designed to help determine the proper alloys for use in a particular application, is also included.

Antenna Handbook

A 14-page handbook containing a selected group of curves of antenna characteristics has been announced by I-T-E Circuit Breaker Co., Engineering Products Section, 601 E. Erie Ave., Philadelphia 34, Pa.

Motor Selector Chart

Characteristics and performance ranges of all fractional hp motor types are charted in detail in a binder sized fractional hp motor selector chart now available from Howard Industries, Inc., 1760 State St., Racine, Wis.

Speed-torque curves for basic motor types are illustrated as well as other motor data.

Overhead Handling

A revised edition of the firm's engineering and application booklet No. 2008-M is available from Cleveland Tramrail Div., Cleveland Crane & Engineering Co., Wickliffe, Ohio.

The booklet covers principal components of overhead materials handling systems. Track design and advantages of supporting it flexibly are described in detail. Included are formulas and figures for comparing various track sections. Among the subjects featured are various carriers for hand, electric and automatic operation, tractors, track switches, standard cranes, transfer cranes and gantry cranes, safety electrification, buckets and grabs.

DO YOU HAVE A TWO-STAGE PRESSURE OR TEMPERATURE CONTROL PROBLEM

MERCOID® HAS THE SOLUTION

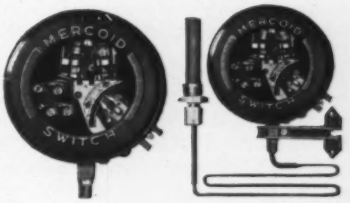
Mercoid DA-400 Series Controls are dual purpose controls (available for pressure or temperature) incorporating a single element operating two separate independently adjustable Mercoid magnetic mercury switches. Circuit arrangements can be supplied for various operations, a few examples are:

1. Close one alarm circuit at high setting and a separate circuit at low setting. Both circuits remain open between the high and low operating points of the two switches.

2. As an electrical interlock to open one circuit on a rise above, and the second circuit on a drop below the set operating point.

3. To provide two-stage control by opening one circuit on a rise and a second circuit on a further rise.

***Pressure types* available in 17 different operating ranges from 0-30" vac. to 300-2500 psi. *Temperature types* available in 11 operating ranges from -30-60°F. to 370-530°F.**



All types are equipped with external adjustments and visible calibrated dial.

Our engineers are at your service—send in your control problem or
WRITE FOR BULLETIN CA-PT

THE MERCOID CORPORATION
4211 Belmont Ave., Chicago 41, Ill.

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Pulse Traps

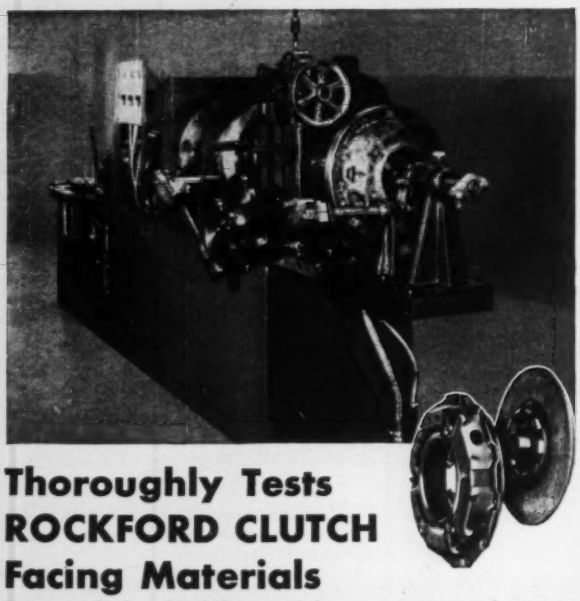
Everett and Everett Engineers, Box 429, Santa Paula, Calif., has issued an eight-page booklet describing operation, applications, performance and sizes of its pulse traps.

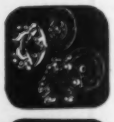
The firm states the traps can be used to eliminate meter error, improve process control, subdue pipeline vibration and augment pumps and compressors.

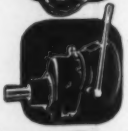
Construction Services

Graver Construction Co., Inc., 424 Madison Ave., New York 17, N. Y., has issued a brochure describing its work in construction for the petroleum, petrochemicals, chemicals nuclear energy, steel, pipeline and power industries. Numerous application photos showing various construction phases are included in the booklet.

ROCKFORD







Thoroughly Tests ROCKFORD CLUTCH Facing Materials

To record the durability and heat resistance of current and newly developed friction material, for ROCKFORD CLUTCHES, two driven-member assemblies are assembled with two flywheels and clutch cover assemblies.

The automatic rotating cams of the engaging device produce repetitive engaging and disengaging cycles of the driving clutch and braking clutch assemblies. 10,000 engagements and disengagements, four cycles per minute, give a very conclusive wear test on the friction facings. The repetition and standardization of this test procedure constitute an accurate analysis of the wearing quality of friction facing materials used in ROCKFORD CLUTCHES.

Let ROCKFORD engineers utilize this testing machine to insure the stamina of the clutch facing material in your products.

ROCKFORD Clutch Division BORG-WARNER

1307 Eighteenth Ave., Rockford, Ill., U.S.A.

Export Sales Borg-Warner International — 36 So. Wabash, Chicago 3, Ill.

CLUTCHES

Automatic Regulators

An eight-page condensed catalog of automatic pressure, temperature and level control valves for automatic process control has just been made available by Atlas Valve Co., 280 South St., Newark 5, N. J.

The brochure describes reducing valves, pump governors, relief valves, temperature regulators, feedwater regulators, float valves, damper regulators and combustion control valves for heating, power generation, chemical processing and other industrial applications where accurate automatic operation is essential for quality control. It is designated Bulletin 56C.

Insulation Material

Microlite insulation, its performance and uses, is described in a four-page brochure recently released by L.O.F. Glass Fibers Co., 1810 Madison Ave., Toledo 1, Ohio.

In addition to thermal and acoustical performance charts, the booklet, WML-5 gives a brief description of how the material is made and what it is made of. Its uses in heating and air conditioning systems, mobile homes, appliances and other industrial and commercial applications are shown.

Heating Elements

A brochure giving several case histories of the application of "Hot Rod" Crystolon heating elements has been published by Norton Co., Worcester 6, Mass.

Precision Brush Finishing

Getting double duty from centerless grinding machines is explained in a four-page brochure, illustrated with photographs and a brush specifications chart, available from Osborn Mfg. Co., Cleveland, Ohio.

It tells how to reduce downtime on centerless grinders by extending their use to precision brush finishing on cylindrical parts. Types of finishing possible and characteristics of brushes needed are described.

Motor Drives

Motor drives with positive pulley adjustment, ranging from $\frac{1}{2}$ to 25 hp, is the subject of a new eight-page bulletin, No. 1610-B1P offered by Worthington Corp., Harrison, N. J.

The bulletin contains information on how to select variable speed drives to meet specialized requirements. It describes engineering features, remote controls, separate motor drive, and other mechanical power transmission products available. Equipped with mounted hand-wheel for fingertip speed control, the motor drives are available with explosion proof motors and can be mounted on the floor, wall or ceiling. The drive features positively adjusted variable pitch pulleys.

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Fork Trucks

Construction details, operating characteristics and maintenance features of the new Clarklift line of fork trucks are described in a 16-page brochure available from Clark Equipment Co., Industrial Truck Div., Battle Creek, Mich.

Photographs and simplified drawings help explain engineering features of the six-model line. A special section on the firm's new Hydratork drive describes the operation and interchangeability features of the power train. The units' two separate braking systems are illustrated and described, as are a number of safety and comfort features.

Meters and Controls

More than one hundred measuring, transmitting, receiving, recording, and indicating instruments and control components for power and process applications are described in an eight-page bulletin released by Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio. Detailed literature reference for each product as well as 24 instrument and control applications are included in the bulletin, G15-1.

Bin Level Indicator

A four-page bulletin describing the firm's material level indicator Model SG-4 is available from Fuller Co., Catasauqua, Pa.

The bulletin describes the use of the level indicator which indicates or controls the level of dry, pulverized, fine, crushed and granular materials passing into or out of a bin, silo, or bunker. Explanation of the two principle functions of the indicator, high level and low level control, an indication, is brought out in both the text and illustrations of the bulletin. Principal functions of the indicator's operation are explained and salient mechanical and electrical characteristics are described in two pages of drawings.

Drill Bit Bulletin

A comprehensive description of one-use drill bits, their construction, specifications, and the preparation of drill rod shanks is given in a bulletin, RD29, published by Le Roi Div. Westinghouse Air Brake Co., Milwaukee 1, Wis.

Photographs and drawings illustrate the offset gage, thinner wings, and steeper reamer angle of the one-use bits. Specifications listing the different sizes and color codes of available bits for different classes and sizes of steel is also included. The principle of the patented connection which provides a firm union between bit and steel is also explained. Preparation of drill rod shanks for this cohesion connection—by grinding, forging, or machining—is explained and illustrated. Recommended heat treating procedures and gaging of shanks are also listed.

Testing Instruments

Custom Scientific Instruments Inc., Kearny, N. J., announces catalog No. CS-56, containing illustrations and brief descriptions of 37 instruments for testing textiles, plastics, paper, insulation, extensometers, dial indicators, light metals and other materials.

Turbo-Charger News

Brown Boveri Corp., 19 Rector St., New York 6, N. Y. has announced that the first issue of its Turbo-Charger News is available for distribution.

Each issue will discuss some specific phase of turbocharging. It is planned to publish the News on a two-month cycle.

WORN Cylinders?

SCORED Cylinders?

PORUS - KROME

Good for the Life of your Engines

is the answer.

- **Reclaim the bores of worn or scored power cylinder liners with wear resistant PORUS-KROME.**
- **Write for detailed information on this economical service for power plants.**

Dept. K-1. VAN DER HORST CORP., OLEAN, N. Y.

OLEAN, NEW YORK — VAN DER HORST — TERRELL, TEXAS

HILVERSUM, HOLLAND — LOS ANGELES, CALIFORNIA*

*SparTan Engineering

Sam Made The PANTS TOO LONG

PRESIDENT, THE CINCINNATI GEAR CO.

Some time ago I had a friend who decided (as I guess everyone has at some time) that the best way to get a good suit would be to buy some cloth that he particularly liked and then have the suit "made to measure" by a tailor. The purchase of the cloth presented no problem, but the selection of a tailor was another matter. He finally chose a small, inconspicuous one-man shop someone suggested to him; the poor fellow who ran it looked half starved, so he assumed he was about to get a real bargain.

After a reasonable wait, he got the suit; but it was a *terrible* fit. He went back for "alterations." It still fit poorly, but he didn't have the heart to go back again to the old man and tell him the truth — that his suit was no good. So, he gave the suit to his yard man.

The moral of this is clear — unless you're a gambler by nature, take your business to a shop that is big enough to do the job right in the first place, or to *make good* if it turns out wrong. This moral holds true whether you're buying suits or custom gears. Our reputation of nearly 50 years of virtually invariable customer satisfaction shows that we are equipped to do the job right — and if, by some chance, there *is* something wrong, we correct it to your complete satisfaction — almost quicker than you can say "Sam, you made the pants too long!"

THE CINCINNATI GEAR CO.
CINCINNATI 27, OHIO
"Gears—Good Gears Only"

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Plastic Pillows

A one-page catalog sheet, illustrating its newly developed polyethylene pillows said to reduce evaporation of liquids in open vessels up to 70 per cent has been published by the American Agile Corp., Box 168, Bedford, Ohio.

The literature points out that the pillows are in essence, small floating tank covers, 1.1 lb of which cover 1 sq ft of surface area with a $1\frac{1}{2}$-in. thick layer. The pillows are chemically inert to almost all reagents, are light in weight, low in cost, and are non-contaminating, the company says. They are $\frac{5}{8}$ in. OD by $1\frac{1}{4}$ by $\frac{1}{4}$ in. Both ends are sealed after air has been introduced for added buoyancy.

Top-Element Control

A bulletin describing model TE of the Robertshaw-Fulton Controls Co. line of top-element temperature controls now is available from the company, 110 E. Otterman St., Greensburg, Pa.

Bulletin RT-771 explains how the control operates to provide top-element temperature regulation. It shows cutaway diagrams of the control and provides information concerning its installation.

Tracing Templates

Tracing templates to aid draftsmen in drawing 24 valves produced by Ross Operating Valve Co., 120 E. Golden Gate Ave., Detroit 3, Mich. are available free from the company. The templates, containing top, side and front views of the valves, are in one-quarter, one-half and full size.

Piping Insulation

A four-page, two-color brochure describing Gilsulate insulation for hot underground pipes has been published by American Gilsonite Co., Salt Lake City, Utah.

The brochure discusses the problems of underground pipe insulation and explains how its insulation's special properties overcome them. On-the-job photographs illustrate ease of application; brief technical data are also included.

Butterfly Valves

A new specification sheet No. RM-1000, describing a line of V-port butterfly valves for precise control of air or gas has been announced by Hagan Corp., Hagan Bldg., Pittsburgh 30, Pa.

The valves are of the rotating vane type. According to the company, a unique self-cleaning vane construction makes the valve suitable for applications involving dirty gas. Excessive dirt accumulations can be quickly and simply removed from the valve body without uncoupling the valve from the gas line; the vane is removable, the firm states. The valves are recommended for gas or air control (excluding steam and water) at pressures below 25 psig. They are not recommended for tight shut-off service. Sizes include 6 to 12 in., with ASA flanged ends.

SAFETY CODES

Now Serving as Guides

to manufacturers, purchasers, and users of equipment and to state and municiple authorities having jurisdiction over the subjects within the scope of these documents.

CODE FOR PRESSURE PIPING
B31.1 — 1955 $3.50

Covers design, fabrication, materials, installation, and testing of the following systems and piping components: power piping, industrial gas and air piping, refinery and oil transportation piping, district heating piping, and refrigerating piping systems.

GAS TRANSMISSION AND DISTRIBUTION PIPING SYSTEMS
B31.1.8 — 1955 $2.50

Design, fabrication, installation, testing and the safety aspects of operation and maintenance of these facilities are covered.

CRANES, HOISTS, DERRICKS
B30.2 — 1943 (Reaffirmed 1952) $2.50

Presents rules for construction, installation, and maintenance of cranes and derricks driven by steam engines, electric motors, or internal combustion engines; for simple drum hoists; overhead electric, and overhead air-hoists; and handpowered derricks.

INDUSTRIAL POWER TRUCKS
B56.1 — 1955 $1.50

Applying to both the driver-ride and driver-lead types, this Code promotes safety to personnel and equipment by establishing uniform fundamentals of certain elements of design and by setting up rules for operation and maintenance of the trucks.

ELEVATORS, DUMBWAITERS, AND ESCALATORS
A17.1 — 1955 $3.50

Gives safety requirements relating to the design, construction, operation, installation, tests, maintenance, alterations, and repairs of hand and power passenger and freight elevators, hydraulic elevators, power and hand sidewalk elevators, private residence elevators and inclined lifts, dumbwaiters, and escalators.

NATIONAL PLUMBING CODE
A40.8 — 1955 $3.50

An up-to-date set of requirements applying to the design, installation, inspection, tests and maintenance of plumbing systems. Contains trailer coach and trailer park standards, and administrative data for law enforcement agencies.

MECHANICAL POWER TRANSMISSION APPARATUS
B15.1 — 1953 $2.00

Contains rules for safeguarding all revolving and reciprocating parts of equipment used in the transmission of power including connecting rods, cranks, flywheels, shafting, pulleys, belts, chains, ropes and drives, gears, clutches, counterweights, belts, keys, set screws, etc.

20% Discount to ASME Members

Published by

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
29 W. 39 St. N. Y. 18, N. Y.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Vertical Turbine Pumps

Bulletin WO-53, published by Layne & Bowler, Inc., Memphis 8, Tenn., describes the firm's water and oil lubricated vertical turbine pumps, their application, and pump drive heads designed for water wells serving industry, municipality and agriculture. The pumps are said by the manufacturer to be practical for use in pumping from lakes, reservoirs and streams.

Nickel Alloys

An illustrated booklet entitled, "Some Properties of Inco Nickel Alloys at Low Temperatures," has recently been issued by International Nickel Co., Inc., 67 Wall St., New York 5, N. Y. The bulletin describes various wrought and cast high-nickel alloys used at low temperatures and which are in current use.

Visible Photo Panels

A four-page, two-color brochure describing visible photo panels and xerography is available from Haloid Co., Dept. HA-2, Rochester, N. Y. The brochure illustrates and explains the use of xerography in the preparation and alteration of lists for visible photo panels, and shows applications with price and parts lists, catalogs, directories, and indexes.

Stationary Field Couplings

Dynamatic Div., Eaton Mfg. Co., Kenosha Wis., has available Bulletin SF-3, illustrating and describing liquid cooled stationary field couplings.

The eight-page brochure details construction, operation and the efficiency of the units, and includes application data and torque characteristics.

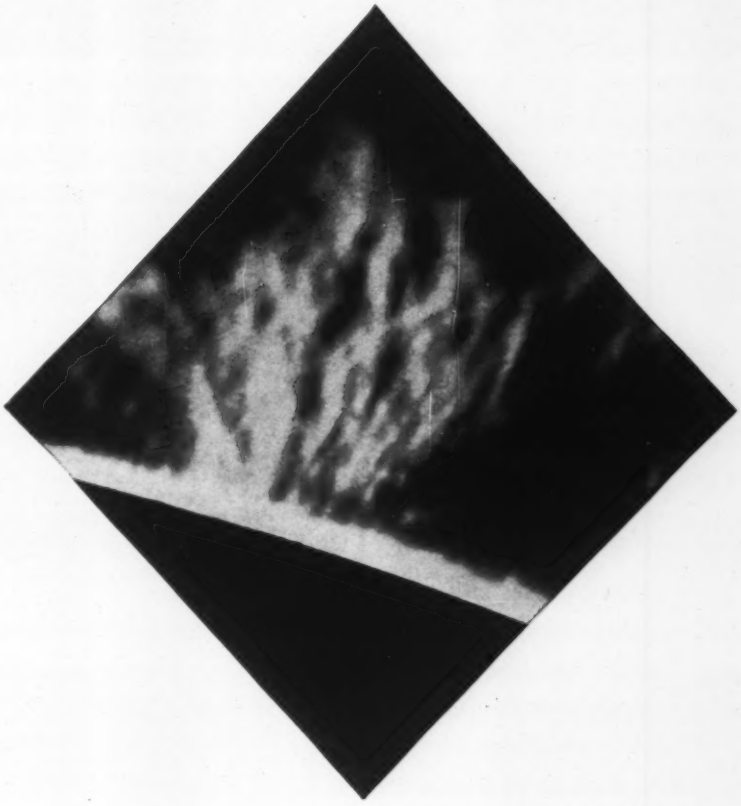
Feeder Bulletin

Pulva Corp., 608 High St., Perth Amboy, N. J. announces the availability of a new condensed catalog, No. 5607, describing its line of Com-bin-feeders. It features pictures of various size units and modifications broadening its field of application and a table of standard sizes and capacities.

Precision Boring Heads

A 12-page catalog 6B, illustrating six standard precision boring heads and a patented adjusting principle for close tolerance boring is available from Briney Mfg. Co., Box 2208, Pontiac, Mich.

The adjusting principle consists of a bushing mounted on pre-loaded ball bearings between the flange and the boring bar. The bushing hole is slightly eccentric with its outside diameter, providing an adjusting range for the boring bar of 0.012 in. in diameter. The principle allows adjustments as fine as $^1/_{10,000}$ in. without loosening or tightening any screws, the firm says.



GOLDEN OPPORTUNITY

Not since the advent of electricity has so golden an opportunity as this knocked at the engineer's door!

It is the horizonless future of nucleonics, the science—and the power—of a whole new age.

Today, a top team of Martin engineers is solving the problems of developing and harnessing nuclear power. Their goal: The development of a fully integrated system of packaged and portable power for military and industrial uses.

If you are interested in this immense field of research and development, contact J. M. Hollyday, Dept. ME-10, The Martin Company, Baltimore, Maryland.

MARTIN
BALTIMORE

SHUR-FLO

new flow switch automatically protects equipment when fluid flow goes below safe minimum . . .

SHUR-FLO

interlock by HAYS

MESURFLO

new water flow rate control delivers set volume regardless of inlet pressures . . .

MESURFLO

control by HAYS

"Mesurflo" is available as an integral part of an infinite variety of electrically operated valves. The "Shur-Flo" interlock may be combined with other Hays control devices. Six technical folders (including diagrams) are available. What's your flow control problem?

HAYS Industrial Sales Division

HAYS MFG. CO.

812 West 12th Street
ERIE, PENNSYLVANIA

Specialists in electrically operated valves, flow controls, and protective devices.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Coupling Selection Chart

A new coupling Selection Chart, available from Morse Chain Co., Ithaca, N. Y., reduces the time necessary to select a flexible coupling to a matter of minutes. The chart, 22 × 17 in., may be hung on the wall, inserted under a glass desk top or folded for filing.

The first step in selecting a coupling is determining the smallest size that will be large enough to accommodate the shafts to be connected. To speed up this step, the firm has condensed the critical specifications of their three distinct types of couplings. The main horizontal headings of the chart are the three coupling types and sizes with the bore diameter range of all coupling halves. NEMA electric motor frame numbers, both old and new, are listed in the extreme left hand column in sequence according to shaft size. The next column lists given shaft sizes.

Brush Springs

Publication of data for the design of constant-pressure brush springs for rotating electrical machinery is announced by the Hunter Spring Co., Lansdale, Pa.

Bulletin 310P describes the principle advantages to be gained from the application of the Neg'ator constant-tension spring as a carbon brush spring. In addition, the 20-page, illustrated booklet discusses physical and operational characteristics, design principles and application limitations of the spring. Brush holder applications are described and illustrated, and design procedures and charts are presented.

Heat Transfer Units

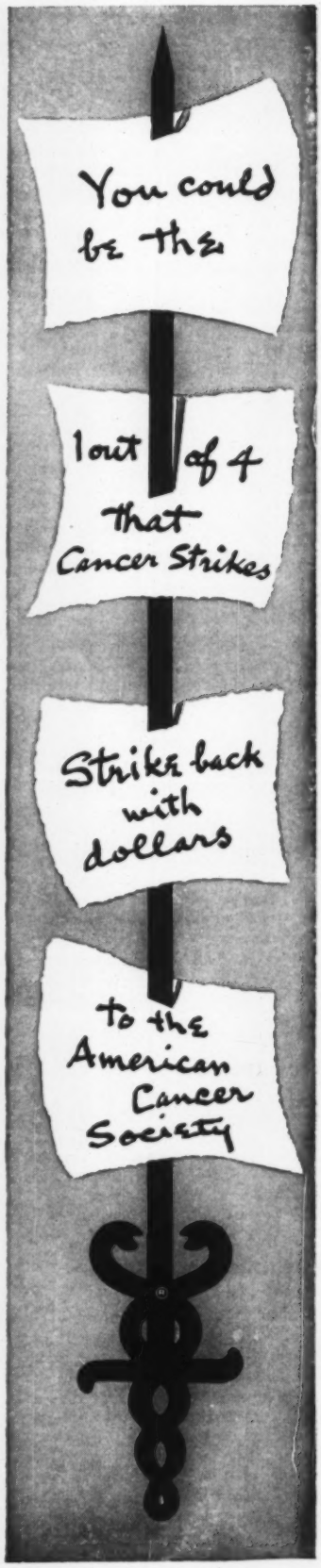
Data on how to cut heat-transfer costs in industrial applications is contained in a new catalog published by Tranter Mfg. inc., Platecoil Div., Lansing 4, Mich.

Bulletin IP-356 features a description of how units are constructed. The bulletin lists and illustrates ten major advantages claimed, and shows how each of them contributes to savings in installation, upkeep, and in initial cost. Sketches are employed to show fourteen actual installations in which the units have been used to solve industrial problems. On-the-job photographs are included of several typical installations.

Plastic Insulation

Bulletin 225, an addition to its existing technical data has been issued on new Franco-Therm plastic insulation by J. H. France Refractories Co., 3142 France Rd., Snow Shoe, Pa.

A special section indexes specific recommendations for use of the product and an engineering graph for estimating proper thicknesses at desired cold face temperatures is included. Graph pinpoints recommended thicknesses where hot face temperatures range from 200 F up to and including 1100 F and cold face temperatures range from 100 F to 230 F.



Complete Missile Organization

needs men with

PhD
MS
BS

Fully intergrated program covers every aspect of major missile building. Intercontinental NAVAHO just one of over 100 sub and major projects. Very interesting engineering climate. Excellent prospects in growing operation. Openings now:

MISSILE ELECTRICAL: SENIOR RESEARCH POSITIONS ARE AVAILABLE FOR ENGINEERS with experience in power generation and distribution, automatic controls, instrumentation, automatic ground check out and service systems, logical design and circuitry and automatic programming and comparison.

FLIGHT TEST INSTRUMENTATION: Research engineers, project engineers and design engineers to be responsible for component and system engineering on radio data transmission, radar beacons, radio telemetering, tracking radar and electronic computing equipment.

ELECTRICAL TESTING: Men with experience in laboratory testing of missile electrical systems and components. Requires ingenuity in developing new testing techniques.

ARMAMENT: A senior position is available for an engineer with an exceptional background in electronic design to be responsible for evaluation and of specialized forms of electrical test equipment. Salary commensurate with responsibility. Advanced degrees preferred. Other positions available for electrical designers, for armament systems and components.

RELIABILITY: Select positions available for senior engineers with experience in design, research or testing to perform the following: design review analysis, statistical analysis, environmental research, reliability test planning and analysis, failure analysis on electronic and mechanical systems and components.

ELECTRICAL MISSILE GROUP EQUIPMENT: This position requires several responsible persons for the design and development of electrical power generation, distribution and conversion. Requires experience in complex electrical circuitries involving electronic components, instrumentation and automatic controls as related to the operation and control of missile electrical power plant, fueling, pressurization, air conditioning, and hydraulic and pneumatic systems.

INTERESTING BROCHURES on Missile Engineering, important to ambitious engineers. For your copy, send your qualifications (card or letter) to:

M. D. Brunetti, Coordinator Engineering Personnel, Dept. 991-C10 ME, 12214 Lakewood Boulevard, Downey, Calif.

MISSILE DEVELOPMENT ENGINEERING

NORTH AMERICAN AVIATION, INC.

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Fluid Drives

An eight-page illustrated two-color catalog, Bulletin 9819, describing new 1 through 25 hp Type VS Class 2 Gyrol fluid drives is now available from American Blower Corp., Detroit 32, Mich.

The catalog discusses advantages and typical applications of the new adjustable speed fluid drives. Design and general construction features are described and illustrated by means of a cutaway view. Close-up photographs of optional speed control mechanisms are also included. A description of the operation of the new units is also given. Selection tables are provided for the line for both direct connection and belt drive arrangements. Installation drawings are also included which give basic dimensions of four new fluid drive sizes for the basic unit and for another arrangement with flange-mounted drive motor.

Pulse Control Systems

"Pulse Patterns For Testing Cores," a technical bulletin published by Electronic Instruments Div., Burroughs Corp., 1209 Vine St., Philadelphia 7, Pa., provides information on pulse control systems to test cores by digital techniques.

Designated Technical Bulletin 136, the 16-page booklet discusses core manufacturing. It states that reliable testing procedures are a must, and points out the need for equipment which not only tests how a core will meet specifications within all necessary ranges of tolerance, but also how it will eventually operate in the system for which it is intended. A number of block diagrams and timing diagrams show how manufacturers and purchasers of cores use the systems.

Precision Bearings

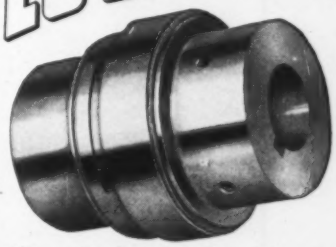
A 128-page catalog listing its line of precision bearings has been published by the McGill Mfg. Co., Inc., Bearing Div., Valparaiso, Ind. A special feature of Catalog No. 52-A is a complete section on engineering data and computations.

The engineering section features a listing of formulas and data for use in determining numerical values for the various leads to which bearings are subjected. These formulas show how to compute horsepower and torque; how to determine values of radial and thrust leads individually and in combination; how to equate distribution of loads in relation to bearing location; and how to equate distribution of loads in relation to bearing location; and how to compute radial loads due to belt, chain, or rope drives. Engineering information is also contained for determining forces that act on various types of gears including straight spur, simple planetary, helical spur, plain bevel, spiral bevel, and worm. Also included are formulas and engineering data on determination of the centrifugal and inertia forces that act on bearings.

15 YEARS SERVICE WITH ONE SET OF CUSHIONS

... actual report on

LOVEJOY



Flexible Couplings

Up to fifteen years maintenance-free service is not unusual with Lovejoy lubrication-free flexible couplings.

Performance like this is practical proof of these soundly engineered features:

SIMPLE, RUGGED CONSTRUCTION
Fewer parts. No intricate mechanisms. Nothing to lubricate.

LOAD TRANSMITTED BY CUSHION COMPRESSION
No wear on the metal jaws.

DOUBLE-LIFE CUSHIONS
One half of the cushions act as idlers—except on reversible loads. A quick interchange provides a new set of cushions. This can be done without dismantling the coupling.

Illustration at right shows a Lovejoy Type CF flange-mounted coupling. Rated at 160 hp., 800 rpm., this space saver connects drive shaft between diesel power unit and generator.

You can get Lovejoy performance for your application.

Let us know your requirements or request complete-line catalog.

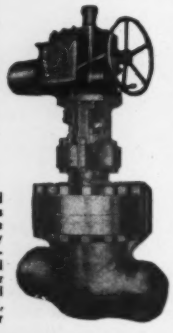
LOVEJOY FLEXIBLE COUPLING CO.

4832 W. LAKE STREET • CHICAGO 44, ILLINOIS

Mfrs. of Flexible Couplings, Variable Speed Pulleys and Transmissions, Motor Bases and Universal Joints.

Check these features

- Micrometer torque seating switch gives tight valve closure, and protects valve parts from damage.
- Self contained unit—no gears, stem nut or bearings to buy.
- Weatherproof, dust-tight, watertight and explosion-proof construction.
- Hammerblow device . . allows motor to reach full speed, before load is engaged.
- Non-rotating handwheel built into the unit.
- Automatic declutching.
- Motor is disengaged during handwheel operation.
- Can always be declutched for handwheel operation regardless of weather or electrical conditions.
- High torque motors.
- Simple valve yoke.
- May be mounted in any position.
- Three to four times faster handwheel operation.
- Actuation may be by any available power source such as electricity, air, oil, gas, water or steam. LimiTorque is readily adapted for microwave control.
- LimiTorque is designed for plug, butterfly, gate and globe valves up to 96" diameter . . . Entire Unit and nut can be lifted off valve yoke, by removing flange bolts.



Send for Catalog L-550 and see why this and other types of LimiTorque Valve Operators are so widely used. See the newest developments in Mechanical Power Transmission at our Booth #80—52nd National Power Show, New Coliseum, New York City, November 26-30.

LimiTorque®

PHILADELPHIA GEAR WORKS, INC.
ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.
Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS
LIMITORQUE VALVE CONTROLS
FLUID MIXERS • FLEXIBLE COUPLINGS

Limitorque Corporation • Philadelphia

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Blower Bulletin

Read Standard Corp., Blower Div., 370 Lexington Ave., New York 17, N. Y., announces availability of a four-page two-color, bulletin B-154A containing charts and engineering information pertaining to the "Standardaire" blower, a compressor adaptable to either pressure or vacuum service.

Selection charts give the blower model, brake horsepower and rpm needed to provide specified air-moving capacities in cfm at required pressures in psig or vacuums in inches of mercury. The unit will handle air, gas or vapor, as modified for each particular service.

Miniature Couplings

Thomas Flexible Coupling Co., Warren, Pa., has issued a four-page bulletin, MC-100, illustrating and describing its miniature couplings for power transmission.

The couplings are designed for use on servo-mechanisms, computers and other small devices. They are rated at speeds to 50,000 rpm, and are suggested for holding synchronism, relieving bearing loads, holding constant torque and handling parallel and angular misalignment.

Industrial Insulations

Owens-Corning Fiberglas, Toledo 1, Ohio, is distributing a comprehensive industrial insulations catalog which describes and illustrates its line of industrial products.

Identified as AIA File No. 37-D, the 132-page publication includes descriptions of Fiberglas pipe, duct, equipment, and cold storage insulations; Kaylo pipe and block insulations, as well as pricing and ordering information, application details, recommended thicknesses and heat gain, multiple layer combinations, operating temperatures, engineering data and general terms and conditions of sale. The products are said to be effective in a wide range of temperatures from zero to 1800 F. Included in the publication are 21 graphs, 104 photographs, 84 sketches and 74 tables.

Photoelectric Controls

Bulletin PA 561, a new, enlarged edition of "Proved Answers to Successful Automation," is being offered to industry by Photoswitch Div., Electronics Corporation of America, 1 Memorial Drive, Cambridge 42, Mass.

The 24-page, illustrated brochure contains specifications, descriptive data and operational charts on packaged photoelectric systems for industrial control applications, including conveyor control, counting, inspecting and sorting, smoke detection and high-temperature measurement and control. Introduced for the first time is a completely new line of miniature and subminiature photoelectric receivers and light sources designed to make possible many new control applications on special machinery and wherever space is limited.

ENGINEERS
. . . DESIGN
. . . MECHANICAL

GM AC

INERTIAL GUIDANCE SYSTEM PROGRAM
ELECTRONICS DIV.,
Milwaukee 2, Wis.

Seeks Engineers with experience in

- Vibration and Stress Analysis
- Mechanical Design
- Electronics Package Design
- Electronics Package Cooling

Enjoy Challenging Opportunities in the most versatile Laboratories in the country. Work with the top men in the field and with the finest test, research and development facilities. We are in the process of a Major, Permanent, Expansion Program. New Plant facilities being added in suburban Milwaukee area.

To aid you in your professional advancement AC will provide financial assistance toward your Master's degree. A Graduate Program is available evenings at the University of Wisconsin, Milwaukee.

GM's Electronics Division aggressive position in the field of manufacture and GM's long-standing policy of decentralization creates individual opportunity and recognition for each Engineer hired.

Recent EE,ME Graduate Inquiries Also Invited

Milwaukee offers ideal family living in a progressive neighborly community in cool, southern Wisconsin where swimming, boating, big league baseball and every shopping and cultural advantage is yours for the taking.

To arrange personal, confidential interview in your locality send full facts about yourself today to

Mr. John L. Heffinger
Supervisor of Salaried Personnel
AC Electronics Div.
General Motors Corp.
Milwaukee 2, Wis.

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Chemical Resistant Coatings

A four-page, illustrated bulletin available from Metal & Thermit Corp., Rahway, N. J., describes three general classes of chemical-resisting organic coatings that have been developed to meet the needs of processing industries.

The three classes are Ucilon coating systems applied like paint for general corrosion control; Unichrome plastisol compounds for heavy-duty service; and Unichrome special materials for lining steel drums and tanks.

Motor Pulleys

A new bulletin No. 1630-B1P, on variable speed motor pulleys has been issued by Worthington Corp., Harrison, N. J.

Featured in the bulletin are motor pulleys, 1/8 through 3/4 hp, available with adjustable and tilting motor bases, companion sheaves, motor bases and V-belts. The bulletin is illustrated by numerous charts that list complete ratings, dimensions and selection data for the various variable speed motor pulleys; the 24 QD sheave stock sizes; and Worthington-Goodyear V-belts.

Vulcanized Fiber

Spaulding Fiber Co., Inc., Dept. ME, 123 W. 22nd St., Baltimore 18, Md., has issued a 36-page catalog covering its lines of vulcanized fiber, thin insulation, laminated thermosetting plastic,motor insulation, fiber board, transformer board, and such materials handling equipment as factory trucks, boxes, barrels and trays.

The booklet also describes the firm's fabricating facilities and lists regional sales offices and factories. Physical properties and specific uses for the various products are given, along with engineering reference data.

Restrictor Tubing

Wolverine Tube, Div., Calumet & Hecla, Inc., Detroit 26, Mich., announces a leaflet on restrictor tubing.

This brochure covers the firm's capilliary tube for restriction purposes, and shows the advantages of plug drawn tubing for metering flow of liquids and gases. Testing and control features, and what they mean for finished products in such industries as refrigeration and air conditioning are included.

Seamless Welding Flanges

A four-page folder published by Tubular Products Div. Babcock & Wilcox Co., Beaver Falls, Pa., is a ready cross reference between the steel, the application and the specification covering various carbon, alloy and stainless steel seamless welding fittings and flanges.

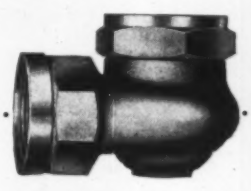
Reference specifications are those of the ASTM, AAR and a number of special specifications covering the products mentioned. The booklet is identified as TDC-186.

Textile Yarns

An eight-page brochure containing facts about the company's textile yarns has been made available by I.O.F. Glass Fibers Co., 1810 Madison Ave., Toledo 1, Ohio.

It offers a description of the product and some end uses and includes a yarn comparison table, listing glass fiber continuous-filament yarn data and equivalent yarn counts of cotton, worsted, and rayon. Glass yarn nomenclature and manufacturing processes are also listed in the booklet which is designated as form TYN-1.

SPRAYING SYSTEMS CO.



for lower cost

and better performance

SPRAY NOZZLES

Modern design. Precision machining. All materials. Thousands of standard industrial spray nozzle types and sizes to choose from. Years of proved experience at your service.

write for this great new catalog today

Ask for our new 48 page Catalog No. 24 . . . the most comprehensive spray nozzle catalog ever produced. Yours for the asking.

SPRAYING SYSTEMS CO.
3265 Randolph Street • Bellwood, Illinois

PPC

You Get Dynamic Hydraulic Balance with

PENNSYLVANIA

MULTI-STAGE THRUSTFRE Centrifugal Pumps

All axial forces are balanced in this THRUSTFRE design. Thru the correct design of the shaft bushing between the opposed impellers, external thrust-control devices are eliminated. This dynamic, hydraulic balance design reduces parts subject to wear and replacement, gives greater operating economy, assures dependable service with minimum maintenance. Write for descriptive bulletin A-242 that shows you too can profit by the many exclusive features found in Pennsylvania Multi-stage Thrustfre Centrifugal Pumps. Performance-proved in hundreds of installations. Discharge pressures to 1200 psig.

PENNSYLVANIA PUMP & COMPRESSOR COMPANY
Main Office & Works, Easton, Pennsylvania
AE-PP328-956 EARNING CONFIDENCE SINCE 1920.

PENNSYLVANIA PPC PUMP AND COMPRESSOR COMPANY

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Die Handling Trucks

A truck engineering bulletin illustrating and describing a new line of die handling trucks for inclined presses has been released by Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 3, Ohio.

The new trucks are said to eliminate the problems normally encountered in die handling on and off medium to large sized inclined presses. They have been engineered with rotating platforms which may be tilted to either side or forward for greater speed and safety in such operations. The booklet contains detailed information on both truck design and operation.

Flow Controls

An eight-page catalog, No. 553, illustrating and describing the company's line of flow controls has just been issued by Fluid Controls, Inc., 1284 N. Center St., Mentor, Ohio.

Basic hydraulic restrictor and needle valves and adjustable, pressure compensated flow regulators are shown in schematic drawings. Capacity ranges, pipe sizes and dimensions of each type are included. Also featured is a section illustrating a wide variety of other models of basic types now available for off-the-shelf delivery.

Positioning Film

A full color 35 mm sound slide film on the Worthington Corp. line of positioning equipment is available.

The new 18-minute narrated film covers the ABC's of welding positioners, automatic manipulators, turning rolls, and provides application tips for eliminating slow production, high labor costs, accident hazards and poor quality. The film may be obtained by writing to Worthington Corp., Advertising & Sales Promotion Dept., Harrison, N. J.

Wire Enamel

A third revision of a technical bulletin on Lecton acrylic resin wire enamel is now available from Du Pont industiral finishes Div., Room 8012, Du Pont Bldg., Wilmington 98, Del.

The 12-page bulletin describes the new magnet wire enamel in comparison with standard polyvinyl formal and nylon wire enamels. The material, according to the company, is substantially superior to polyvinyl formal in heat aging characteristics and may be considered a candidate for Class B (130 C) insulation. It is also superior to nylon in many important properties and is lower in cost.

Electronic Cleaner

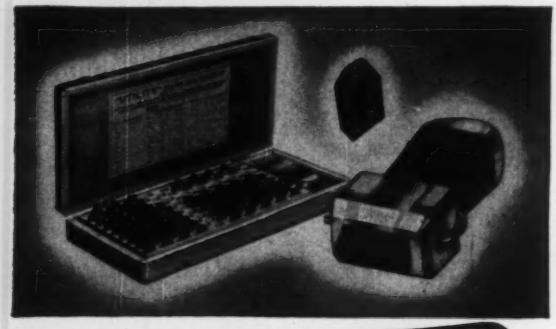
An eight-page catalog, E-40, covering its packaged electronic air cleaners has been released by Trion, Inc., 1000 Island Ave., McKees Rocks, Pa. The new book describes custom-built models and includes engineering data and size and capacity tables for fitting the proper model to the job.

The cleaners are built into the return air duct of heating or air conditioning systems. They are said to remove practically all airborne dirt, soot, pollen, germs and other particles. The particles receive a positive electric charge and are then attracted to grounded aluminum plates.

Sampling Valve

A two-page data unit No. 294 gives details and features of new drain or sampling valve in sizes from $^3/_4$ up to 2 in. produced by Jerguson Gage & Valve Co., 80 Fellsway, Somerville 45, Mass.

The valve is available in two types of construction according to size, both with constructions featuring a valve stem seating outside the valve body and OS & Y construction to meet high temperature and corrosive conditions. Detailed specifications and engineering drawings are included.



THE SAFETY "UTILITY"
MARKING OUTFIT

Holder Holds Nine Sizes of Type From 1/32" to 1/4"

Designed for light stamping work, the "Utility" outfit is ideal for marking etched plates, tags, keys, stock checks; brand names or stock numbers on steel bars; special coding, serial numbering, identification, inspection and other marking where two or more characters are required.

Send for "UT" Circular.

Mecco SAFETY MARKING TOOLS
M.E.CUNNINGHAM CO.
1473 NORTH AVENUE, PITTSBURGH 33, PA.

The ADDED Ingredient...
KNOW-HOW—
...HAS MADE
DUDEK & BOCK
THE Leader!
WIRE FORMS
SPRINGS
METAL STAMPINGS
In Industry, in homes, farms and shops, you'll find daily, living proof that D-&-B's KNOW-HOW pays out in EXTRA performance. Rely on expert engineers for parts that meet your exact needs and save you MONEY! Get Wire Forms, Springs and Stampings that are easily assembled . . . that withstand stress . . . and perform under the most trying conditions!
Write for FREE Brochure
SPEEDY DELIVERY
WRITE — WIRE — or PHONE
for Estimates and Delivery Dates
Phone: DICKENS 2-1020
DUDEK & BOCK
SPRING MFG. CO.
4014 W. Grand, Chicago 51, Ill.

there's a combination starter you KNOW is Safe!

Bulletin 712 Combination Starter consists of a standard Bulletin 709 across-the-line starter mounted in a cabinet with an A-B manual disconnect switch. Fuse clips are optional.

OPERATING LEVER CAN BE PADLOCKED IN "OFF" POSITION

You can use from one to three padlocks to lock this starter in the "off" position—or, for unusual applications, change it to permit padlocking in the "on" position.

TO OPEN COVER LEVER MUST BE IN "OFF" POSITION

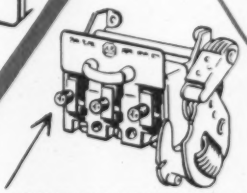
The disconnect switch lever is so interlocked that the cover of the cabinet cannot be opened until the disconnect switch is "open" and the starter is "dead."

COVER ITSELF CAN BE PADLOCKED

Provision for locking the cover to the base of the cabinet with a padlock eliminates all possibility of tampering with the mechanism.

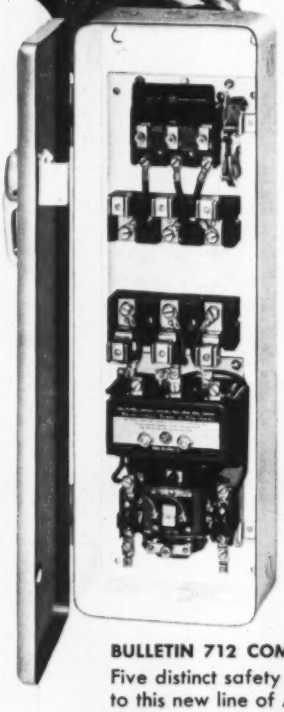
INSULATING SHIELD COVERS "LIVE" LINE TERMINALS

With the cover open, only the incoming line terminals are "alive"—and in Allen-Bradley Bulletin 712 starters, these are covered with an insulating shield.



MOVABLE CONTACTS ARE PLAINLY VISIBLE IN "OFF" POSITION

When in the "off" position, the movable disconnect switch contacts show above the arc hood in plain view. Welded or sticking contacts can be detected instantly—a reliable safety signal.



BULLETIN 712 COMBINATION STARTER

Five distinct safety features give "plus value" to this new line of Allen-Bradley Bulletin 712 Combination Starters. And—you also get the design simplicity and the many other advantages for which the Allen-Bradley solenoid starter has earned its "quality" reputation.

Available in NEMA Types 1, 4, 7, 9, and 12 enclosures, from 1 to 100 hp, 220v; 200 hp, 440-550v.

8-56-MR

A-B Quality

ALLEN-BRADLEY

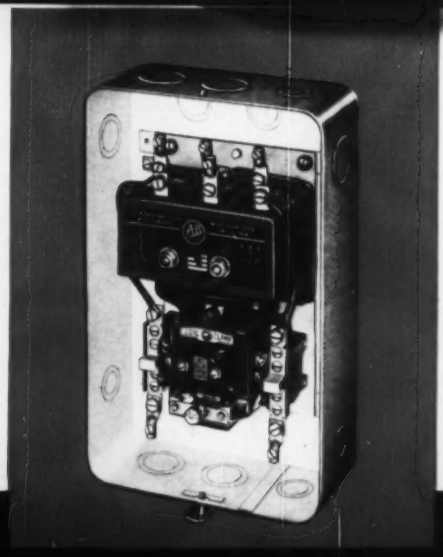
MOTOR CONTROL

QUALITY

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.

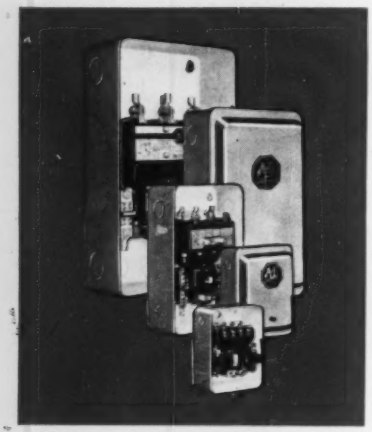
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

This simple design remains "tops"



Only one moving part–

that's why it's good for millions of operations!



Shown above are five sizes of the Bulletin 709 across-the-line solenoid starters. Three larger sizes are also available with a maximum rating of 300 hp, 220 volts; 600 hp, 440-550 volts.

The solenoid plunger shown above is the only moving part in any Allen-Bradley solenoid starter. Its straight up-and-down action is practically frictionless. There are no pivots, pins, or hinges to stick and cause trouble. That's why you are assured of millions of trouble free operations.

All Allen-Bradley solenoid starters have double break, silver alloy contacts that never need service attention of any kind. You just install them and forget them. On more and more automatic production machines, where continuity of operation is a "must," Allen-Bradley motor starters are standard equipment. Try them on your tough jobs!

A-B Quality

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL
QUALITY

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

8-56-MR

UCRL

UNIVERSITY OF CALIFORNIA RADIATION LABORATORY • *Berkeley* *Livermore*

Could *you* contribute new ideas to these new fields?

Nuclear Weapons
Nuclear Rocket Propulsion
Controlled thermo-nuclear energy
Particle accelerators
High-speed digital computers
Critical assembly and reactor research

These are six of the challenging projects now underway at the University of California Radiation Laboratory—managed and directed by some of America's foremost scientists and engineers.

You are invited to join them... share their pioneering knowledge in nuclear research... use their expansive facilities ...and help to do what has never been done before.

IF YOU are a **MECHANICAL** or **ELECTRONICS ENGINEER,** you may be involved in a project in any one of these fields, as a basic member of the task force assigned each research problem. Your major contribution will be to design and test the necessary equipment, which calls for skill at improvising and the requisite imaginativeness to solve a broad scope of consistently unfamiliar and novel problems.

If you are a **PHYSICIST** or **MATHEMATICIAN** you may be involved in such fields of theoretical and experimental physics as weapons design, nuclear rockets, nuclear emulsions, scientific photography (including work in the new field of shock hydro-dynamics), reaction history, nuclear physics, critical assembly, high current linear accelerator research, and the controlled release of thermo-nuclear energy.

If you are a **CHEMIST** or **CHEMICAL ENGINEER,** you will work on investigations in radiochemistry, physical and inorganic chemistry and analytical chemistry. The chemical engineer is particularly concerned with the problems of nuclear rocket propulsion, weapons and reactors.

In addition, you will be encouraged to explore fundamental problems of your own choosing and to publish your findings in the open literature.

And for your family—there's pleasant living to be had in Northern California's sunny, smog-free Livermore Valley, near excellent shopping centers, schools and the many cultural attractions of the San Francisco Bay Area.

You can help develop tomorrow—today at UCRL

Send for complete information on the facilities, work, personnel plans and benefits and the good living your family can enjoy.

UCRL

53-1-1

DIRECTOR OF PROFESSIONAL PERSONNEL
UNIVERSITY OF CALIFORNIA RADIATION LABORATORY
LIVERMORE, CALIFORNIA

Please send me complete information describing UCRL facilities, projects and opportunities.

*My fields of interest are*_____

*Name*_____

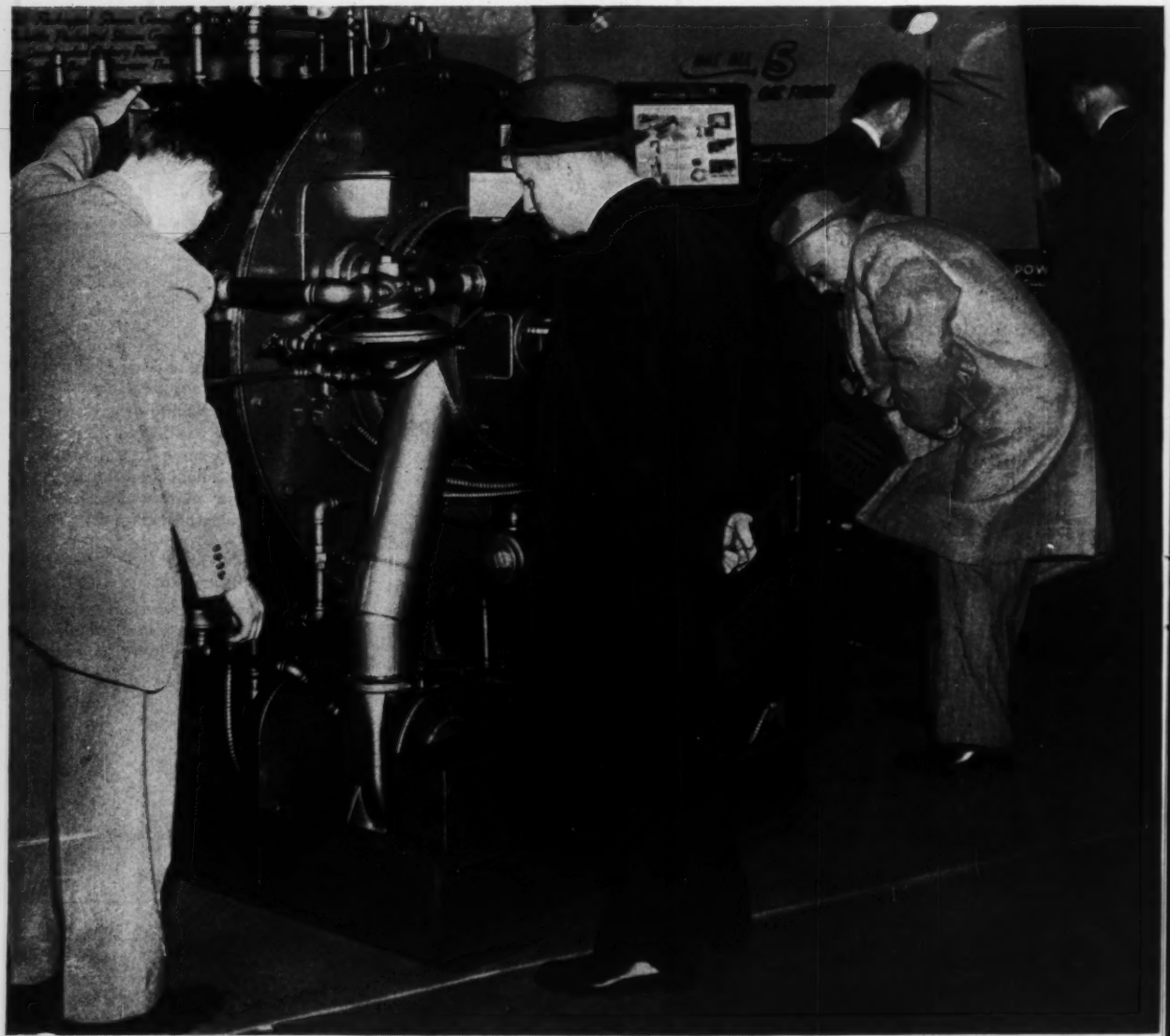
*Address*_____

*City*_____ *Zone*____ *State*_____

How to Get Good Ideas

. . . Come, and Bring Your Key Men
To See and Profit at the:

22nd National Exposition of



Power & Mechanical Engineering

Under auspices of ASME

NOV. 26-30, 1956

in New York's great new COLISEUM

SEE the latest techniques for the efficient generation and utilization of all types of Power...new techniques for plant modernization, expansion, maintenance, economy.

SEE America's greatest exhibition of products and services applying to Power.

SEE a new, enlarged Atomic section...learn about the latest industrial applications of atomic energy.

SEE and talk to hundreds of technical representatives of leading manufacturers ready to help solve *your* problems.

SEE IT ALL in America's newest and most modern showplace —New York's Coliseum. You'll see everything in complete comfort—and the Coliseum is just minutes from ASME meetings.

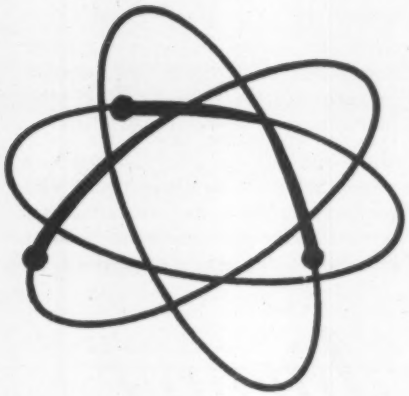
It's the one time of the year when the *best* ideas are gathered together for your benefit.

Save time, fill out and mail coupon right now for advance registration:

22ND NATIONAL EXPOSITION OF POWER & MECHANICAL ENGINEERING

480 Lexington Ave., New York 17, N. Y.

MANAGEMENT: INTERNATIONAL EXPOSITION COMPANY



22ND NATIONAL EXPOSITION OF POWER & MECHANICAL ENGINEERING
480 Lexington Avenue, New York 17, N. Y.

Please register the following in advance and forward identification badges:

NAME_____ **TITLE**_____

NAME_____ **TITLE**_____

NAME_____ **TITLE**_____

COMPANY NAME_____

COMPANY ADDRESS_____

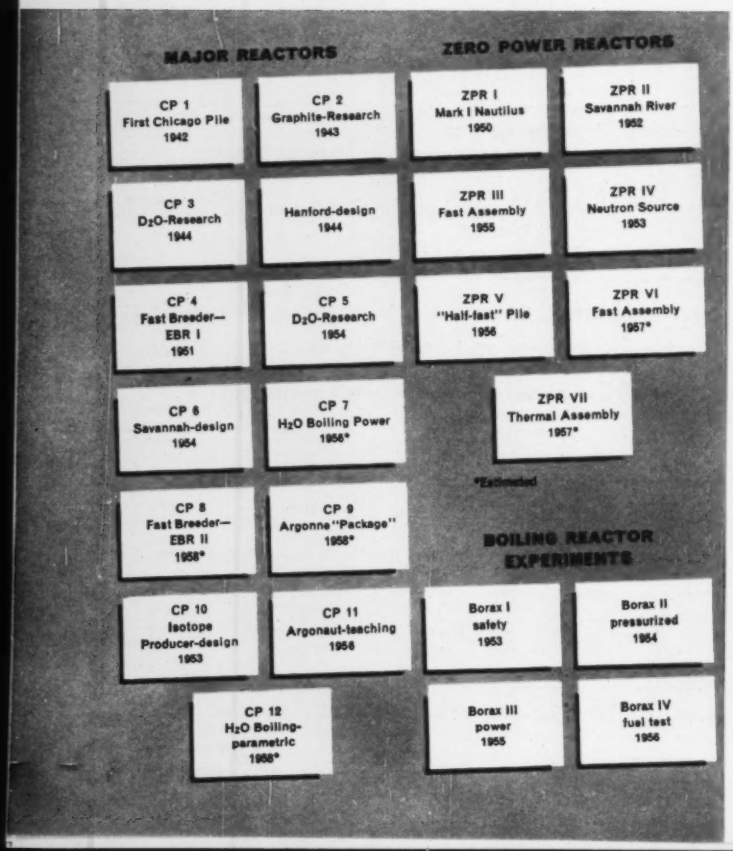
CITY_____ **ZONE**_____ **STATE**_____

COMPANY'S BUSINESS, SERVICE OR PRODUCT_____

3305

ON DECEMBER 2, 1942
MAN ACHIEVED HERE
THE FIRST SELF-SUSTAINING CHAIN REACTION
AND THEREBY INITIATED THE
CONTROLLED RELEASE OF NUCLEAR ENERGY

Ingredients of Leadership



. . . a unique combination of basic, fundamental and applied research . . . administration by scientists for scientists . . . atmosphere and facilities conducive to creativity . . . a dedication to knowledge of interest and significance to the individual . . .

. . . the best of academic and industrial research practices . . . effective inter-disciplinary approach to major problems . . . a penchant for solving unsolvable research and engineering problems . . .

. . . opportunity for unlimited professional growth and expression . . . minimum direction . . . equivalent salary recognition for the individual who does not assume administrative responsibilities . . .

Now expanding our staff for the first time in a number of years. Scientists and engineers who hunger for intellectual and creative satisfaction are offered an extraordinary opportunity to become associated with the challenge that is offered at . . .

Argonne
NATIONAL LABORATORY
Professional Personnel Office
P. O. Box 299 • Lemont, Illinois

Hollow Mill Maker finds

DBL-2
High Speed Steel

HARD, TOUGH and VERSATILE

The maker of these adjustable hollow mills required a steel that would give top performance in a variety of jobs—turning, tapering, facing, chamfering and trepanning. After thorough testing, Allegheny Ludlum's high speed DBL-2 was selected.

DBL-2 is an improved general-purpose high speed steel. It contains tungsten, molybdenum and vanadium in such proportions that it excels 18-4-1 for most applications. DBL-2's unusual combination of high hardness with toughness, its ability to hold a fine grain over a wide hardening range, and the fact that it easily machines many diverse types of stock, made it particularly well suited for this job.

In addition to these advantages, DBL-2 can be heat treated in the same furnaces and atmospheres as 18-4-1 without fear of harmful decarburization. These DBL-2 blades were heated to 2250 F., oil quenched and drawn twice at 1025 F. After heat treatment, blades easily machined such stock as aluminum, stainless steel, carbon steel, aircraft steel, plastics, bronze, screw stock, cast iron and brass.

There is an A-L tool steel to meet your toughest requirements. Call your A-L representative or distributor today . . . or write *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania.*

Write For Copy of
"CUTTING TOOL MATERIALS"
This 36-page illustrated booklet analyzes and compares types and covers grade selection for all major classes of cutting tools, etc., invaluable data for production men. Write for your copy today.
Address Dept. ME-82

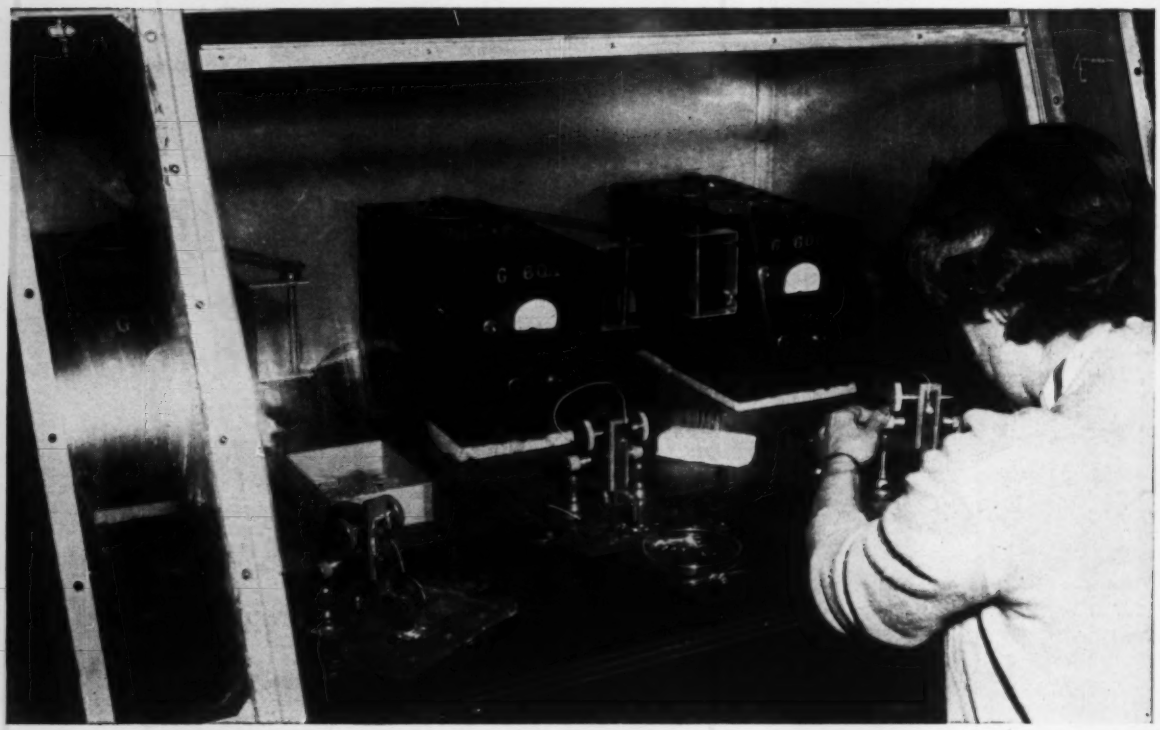
For complete **MODERN** Tooling, call

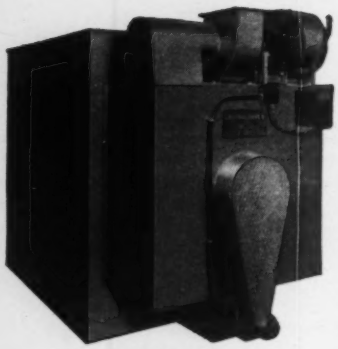
Allegheny Ludlum

WSW 5380 B

AL® FINE TOOL STEELS SINCE 1854

Radio Receptor's diodes are assembled under glass in a DRY atmosphere





Type CH Air-Drying Lectrodryer

A Lectrodryer maintains the extreme DRYness required

Moisture is locked out of this chamber in which germanium gold-bonded diodes are being assembled at Radio Receptor's Brooklyn, New York, plant. A constant supply of DRY air from Lectrodryer keeps the flow of air outward. This makes certain there's no moisture present to impair the high quality of these precision products.

More and more manufacturers are learning how vital DRYness is in the production and operation of electronic equipment. Moisture is a hazard which cannot be tolerated, if quality is to be maintained and procedures standardized.

You may be dealing with small volumes of air, as here at Radio Receptor Company, or with entire workrooms. There are Lectrodryers to handle any volume and any degree of DRYness. Tell your DRYing problem to Pittsburgh Lectrodryer Company, 335 32nd Street, Pittsburgh 30, Pa. (a McGraw Electric Company Division).

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

* REGISTERED TRADEMARK U. S. PAT. OFF.

*Snap-tite

QUICK-CONNECT

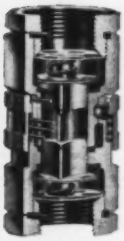
QUICK-DISCONNECT COUPLINGS

in larger sizes

immediate delivery

FROM FACTORY STOCKS

Snap-Tite's "H" Couplings are now factory-stocked for quick shipment to you, not only in the smaller sizes (below 1" ID) but in all sizes up to and including 3"—in steel, brass, aluminum, and 303 and 316 **Stainless Steel.** And "H" Couplings can be made to your order, up to 10" ID.



Available with valves to give two-way or one-way automatic line shut-off, or without valves for straight-thru flow, "H" Couplings are built to handle high pressures in hydraulic and air systems.

Recessed valve washers . . . fluted valve stems . . . valve stops with minimum flow restrictions . . . large inside diameter—allow maximum flow capacity with lowest pressure drop.

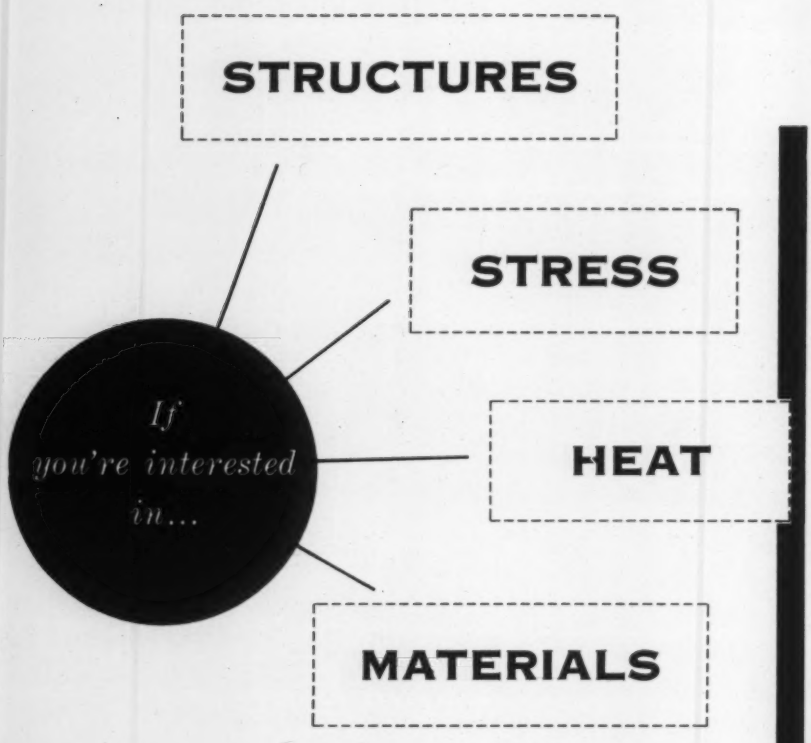
See the Snap-Tite representative in your city or write for Bulletin 240.

SNAP-TITE'S "H" COUPLING, SIZE FOR SIZE, IS THE SMALLEST COUPLING WITH HIGHEST STRENGTH AND HIGHER EFFICIENCY

*Snap-Tite, INC.

UNION CITY 4, PENNSYLVANIA

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS



there's an exceptional opportunity for you at Hughes.

There are many excellent openings for mechanical and aeronautical engineers for challenging assignments in the areas of high-speed missiles, aircraft structures, and antennas. This work concerns developing practical solutions to both theoretical and actual problems of heat transfer, structural analysis and design, stress analysis, materials section, and instrumentation.

The projects at Hughes have both military and commercial potential. Men qualified for these activities are assured of a practically unlimited future in a career with the West's leading center for advanced electronics.

You owe it to yourself to investigate this opportunity to earn a top salary while working with leading scientists and engineers in the ideal climate of Southern California. Mail us your resume to qualify for personal interviews.

Scientific Staff Relations

HUGHES

Research and Development Laboratories
HUGHES AIRCRAFT COMPANY
Culver City
California

A few of our openings include:

ENGINEERS
For the analysis and design of missile structures and other airborne equipment. Also adhesives engineers, metallurgical and materials engineers with aircraft or missile design experience.

MECHANICAL ENGINEERS
To participate in the design and development of missiles, missile launchers, aircraft structure, component installation, environmental test equipment and general mechanical design.

AERONAUTICAL ENGINEERS
For the analysis and design of missile launching equipment for high-speed aircraft, including coordination and liaison with many major airframe manufacturers.

DYNAMICS ENGINEERS
To work on shock and vibration problems in an aerothermal environment. Also elasticians to work on advanced aerothermoelastic problems associated with high-speed flight.

ENGINEER
For research related to the selection of materials and development of fabrication techniques.

LIAISON ENGINEER
To work between Development Laboratories in Culver City and Engineering Laboratory in Tucson or between the Laboratory and subcontractors.

THERMODYNAMICIST
To perform analytical and experimental analysis of heat transfer from electronic components via natural convection, forced-air convection, and radiation.

These positions also available in the Research and Development activity at Tucson, Arizona.

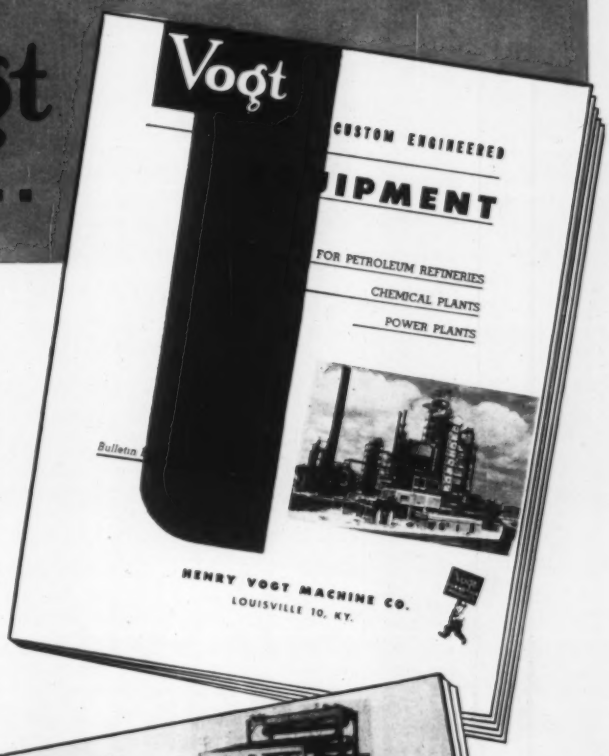
See...

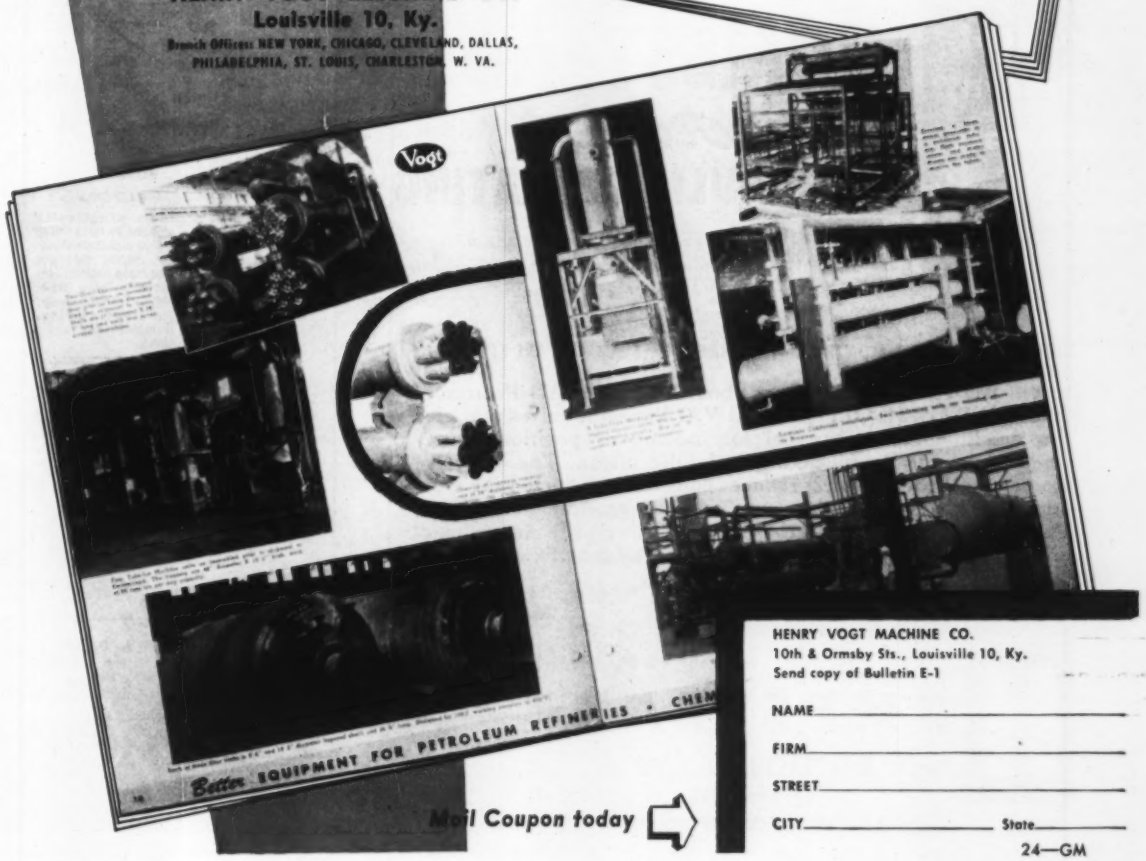
WHAT Vogt CAN DO FOR YOU..

Bulletin E-1 shows Vogt's advanced designs in heat exchangers, reactors, oil chillers, crystallizers, pressure vessels, steam generators and ice making and refrigerating machinery for countless applications in petroleum refineries, chemical plants, power plants and related industries.

Use the handy coupon below and send for your copy!

HENRY VOGT MACHINE CO.
Louisville 10, Ky.
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.





Mail Coupon today

HENRY VOGT MACHINE CO.
10th & Ormsby Sts., Louisville 10, Ky.
Send copy of Bulletin E-1

NAME_____

FIRM_____

STREET_____

CITY_____ State_____

24—GM

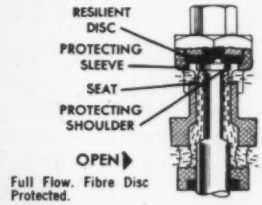
for fast, smooth, accurate control

Specify HOMESTEAD *Protected Seat* HYDRAULIC OPERATING VALVES

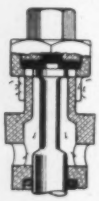
RECORDS OF 6 TO 18 MONTHS' MAINTENANCE-FREE SERVICE ARE COMMON

It will pay you to get the facts about HOMESTEAD Protected-Seat HYDRAULIC OPERATING VALVES—the valves that give you quick, finger-tip control for moving or positioning any single-acting or double-acting hydraulic piston. The exclusive Homestead Protected-Seat reduces fluid velocity during the closing operation to practically zero. Thus seat erosion and resultant leakage, the most frequent cause of shut-downs and lost production time, is eliminated. Records of 6 to 18 months continuous service without maintenance are common.

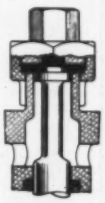
HERE'S HOW THE PROTECTED SEAT WORKS



OPEN ▶
Full Flow. Fibre Disc Protected.



CLOSING OR ◀ OPENING
Flow practically stopped by close fitting sleeve and stem shoulder, before seat and disc make contact. This prevents "wire drawing." Trapped water cushions closing, dampens hydraulic shock.



CLOSED ▶
Protected resilient disc against metal seat assures drop-tight seal, long life, accurate control, and low maintenance.

For full particulars, MAIL THE COUPON TODAY.

HOMESTEAD
VALVE MANUFACTURING COMPANY
"Serving Since 1892"
P.O. BOX 38 CORAOPOLIS, PA.

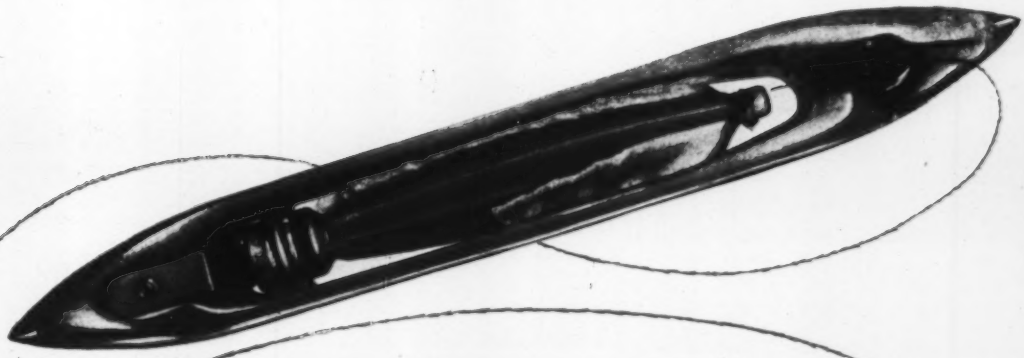
Please send me without obligation, complete data on PROTECTED-SEAT HYDRAULIC OPERATING VALVES.

NAME_____

COMPANY_____ TITLE_____

ADDRESS_____

CITY_____ STATE_____



How Formica-4 helped develop a superior shuttle

A long search for a better shuttle was brought to a successful conclusion recently when Draper Corporation announced its sensational new "Tru-Mold." The new shuttle lasts 2 to 3 times longer than previous types. It's a perfect example of how Formica-4, the complete laminated plastics service, provides better materials for new uses.

After many attempts to replace the traditional dogwood shuttle, Draper and Formica's research engineering developed a molded laminated plastic shuttle that promised to match Draper's high standards. Extensive mill trials showed greatly reduced loom stops because: Formica completely resists the atmospheric conditions in the weave room, and molding holds the metal parts in perfect alignment and correct position *permanently*.

The same coordinated Formica-4 service that assisted in this development may be successful in solving your materials problem. It provides research and application engineering, unmatched fabricating facilities and a stock service plan. Send for your free copy of Formica-4 bulletin. Formica Corporation, subsidiary of American Cyanamid, 1-4611 Spring Grove Ave., Cincinnati 32, Ohio.

FI-1319

CYANAMID

FORMICA 4

1 Application engineering
2 Research
3 Fabricating
4 Complete stock service

1st choice in laminated plastics

Formica Corporation:

Please send me at once and without obligation my copy of Formica-4 bulletin 584.

NAME

COMPANY

ADDRESS

CITY ZONE STATE

ENGINEERS...

Help develop the world's first nuclear powered fleet

Nuclear power offers tremendous advantage for naval vessels. From the fuel standpoint, cruising ranges are virtually unlimited—even at new high speeds. No refueling facilities will be required to replenish nuclear propulsion fuel. Therefore, the physical design of the fleet can be streamlined for greater efficiency and safety.

At the country's largest design-engineering center for nuclear power reactors, Bettis Plant in Pittsburgh, operated for the Atomic Energy Commission by Westinghouse, the application of nuclear power has progressed rapidly. However, the nuclear power plants already in operation today represent only the beginning of a new technological era. *Major advances in many areas are necessary.*

The complexities of handling nuclear materials and controlling the reactor have opened up a whole new field in mechanism design. Atomic power plant equipment requires engineers who are capable of developing the unique valves and pumps that are required in the primary system of a pressurized water reactor. In addition, boilers, heat exchangers, steam generators and other plant equipment require special design and development work.

To do this, Bettis Plant needs farsighted men. Regardless of your interest, you can choose a place in the varied operations at Bettis Plant.

Atomic experience is not necessary.

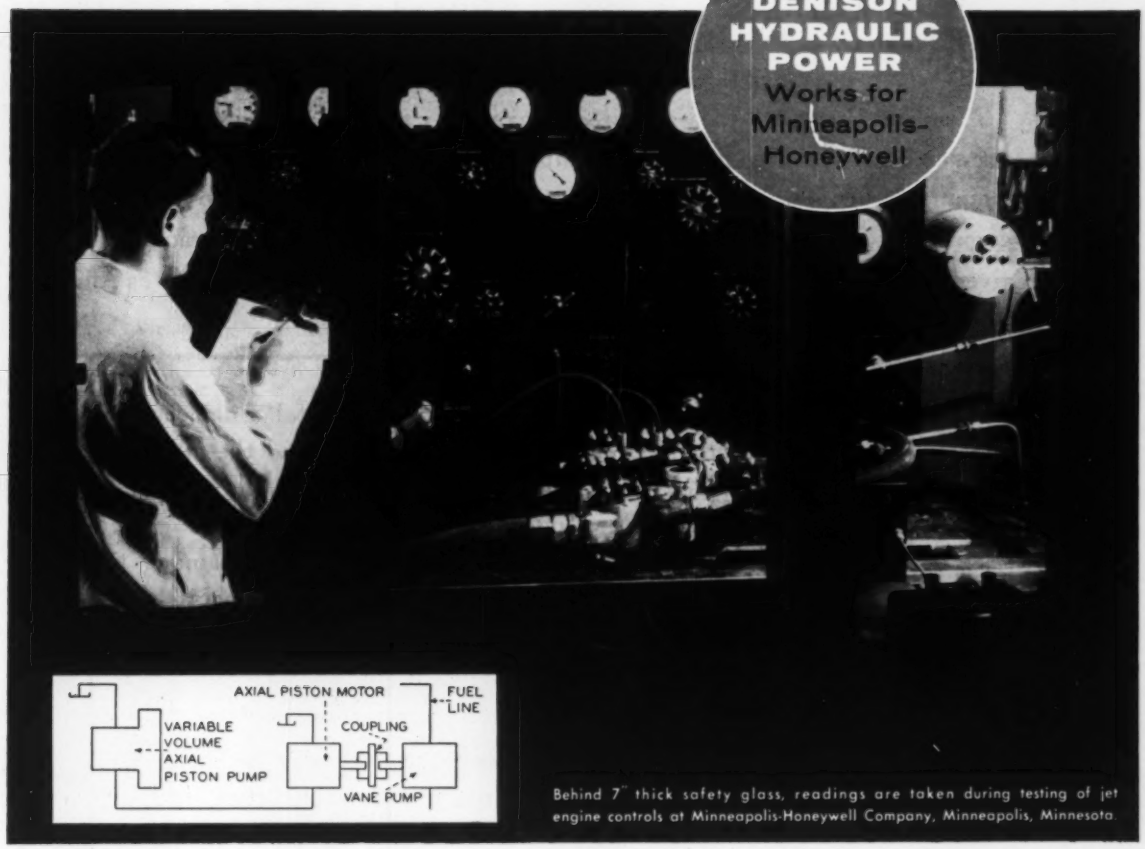
What's more, Bettis Plant is in Pittsburgh's South Hills. Here you can enjoy good living in pleasant suburbs near the plant, and still be convenient to one of the nation's most progressive metropolitan areas.

Educational opportunities are exceptional. Westinghouse helps you continue your studies at any one of three Pittsburgh universities.

Write for descriptive brochure on opportunities in your field. Be sure to specify your interests. Address Mr. A. M. Johnston, Westinghouse Bettis Plant, Dept. A74, P.O. Box 1468, Pittsburgh 30, Pa.

BETTIS PLANT
Westinghouse

How **DENISON HYDRAULIC POWER** Works for Minneapolis-Honeywell



Behind 7" thick safety glass, readings are taken during testing of jet engine controls at Minneapolis-Honeywell Company, Minneapolis, Minnesota.

Providing the muscle power for a "ghost" engine

Denison Variable Volume Axial Piston Pump remote controlled.

A unique electronic system developed by Minneapolis-Honeywell to pre-test jet engine controls now eliminates the cost of building and operating a special engine test cell. The system actually produces a more accurate record of performance than would be possible if the actual engine were used.

The system works this way. An analog computer takes the place of the jet engine. Performance data and other characteristics are received from the manufacturer. These are then simulated on the computer and reproduced as electrical signals, which, in turn, run the engine controls.

To provide dependable muscle power for this control system, Minneapolis-Honeywell relies on Denison hydraulic pumps and motors. The key unit, a Denison Variable-Volume Axial Piston Pump is the prime mover for a Denison axial piston motor that in turn powers a Denison vane pump to deliver jet fuel.

Denison hydraulic equipment is today serving all industries by cutting operating costs, speeding production, and improving reliability. Let a Denison field engineer show you how you can benefit from Denison's hydraulic experience. Write Denison Engineering Division, American Brake Shoe Co., 1174 Dublin Road, Columbus 16, Ohio.

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

DENISON HydrOILics

TO THE MEMBERS OF———

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may associate with the Society as Affiliates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

C. E. Davies, Secretary
The American Society of Mechanical Engineers
29 West 39th Street, New York 18, N. Y.

Date.....

Please send an application and information regarding ASME to the following:

(1) Name.....
Address.....
.....

(2) Name.....
Address.....
.....

(3) Name.....
Address.....
.....

Member's Name.....
Address.....
.....

ME-10-56

NOTHING *can equal* *Stainless Steel*

for its combination of desirable properties

No other design material can match Stainless Steel in its combination of desirable properties: corrosion resistance, strength and hardness, beauty, cleanability and easy fabrication. When seeking a source of supply, remember that United States Steel offers you the widest range of types, finishes and sizes.

For Consumer Appeal. General Ionics Corp. is the first company to offer an all Stainless Steel water conditioner. Sales have boomed because of its handsome appearance and complete freedom from corrosion problems. The company even offers a 10-year warranty to prove their faith in USS Stainless Steel.

For Long Life. All over the country, dairies are switching to Stainless Steel milk cans because they never have to be plated, the smooth surface does not harbor milk solids and bacteria, and, for all practical purposes, the Stainless milk can simply will not wear out.

For Corrosion Resistance. Laboratory fume hoods at the New Jersey Zinc Company used to last no more than 18 months—and sometimes they looked like sieves after only three months. They replaced the hoods and piping with Stainless Steel, and after five years they still look like new.

UNITED STATES STEEL CORPORATION, PITTSBURGH
AMERICAN STEEL & WIRE DIVISION, CLEVELAND
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
NATIONAL TUBE DIVISION, PITTSBURGH
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

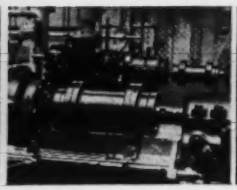
USS STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS
PIPE · TUBES · WIRE · SPECIAL SECTIONS

USS

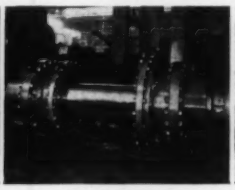
UNITED STATES STEEL

Paper Industry

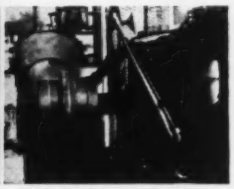


Oil and Gas Industry

Marine Industry

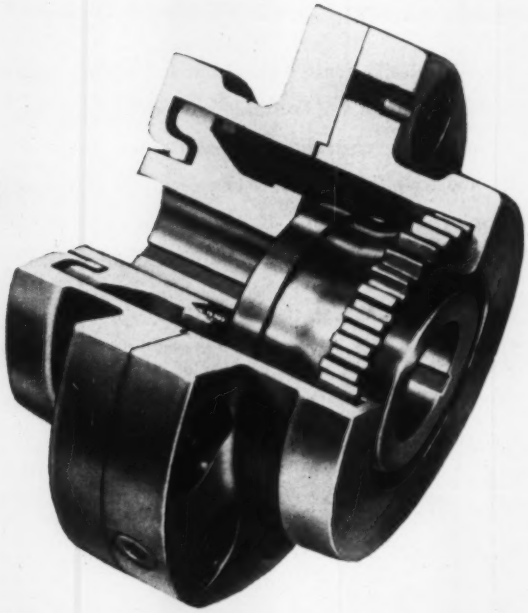


Steel Industry

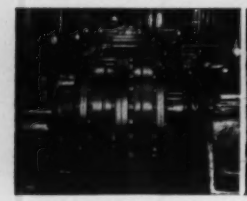


Oil and Gas Industry

Why have Fast's Couplings always been the leader in the rugged steel industry?

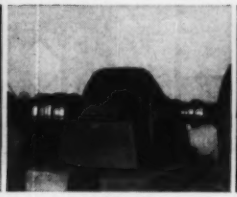


Why are they used so widely to couple machinery in Power Generation, Pulp and Paper, Oil and Gas, Marine Propulsion and Auxiliaries, Steel and industry in general?

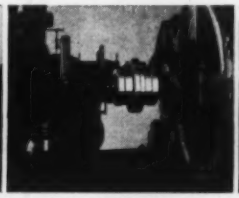


Steel Industry

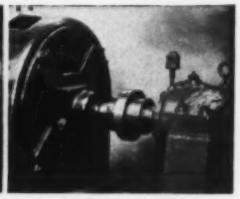
Power Industry



Lumber Industry



Chemical Industry



Paper Industry

Fast's Couplings are standard equipment with more machinery manufacturers than any shaft coupling on the American market. Many Fast's Couplings in use over 30 years still show no signs of wear when disassembled! That's the answer: they're reliable, they're *mechanically* flexible, they don't wear. They have no parts subject to repeated bending, tension or compression. There is no metal-to-metal contact, because of *positive lubrication.* Regardless of your field — no matter whether your connected machine is driven by steam turbine or electric motor, low-speed diesel or high-speed gas turbine . . . Koppers has the perfect, low-cost solution to your shaft coupling problem.

For free catalog write to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.,* 3410 Scott St., Baltimore 3, Md.

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE 3, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Aeromaster Fans, Industrial Gas Cleaning Apparatus, Gas Apparatus.

Engineered Products Sold with *Service*

KOPPERS

THE ORIGINAL *FAST'S Couplings*

Powell Lubricated Plug Valves

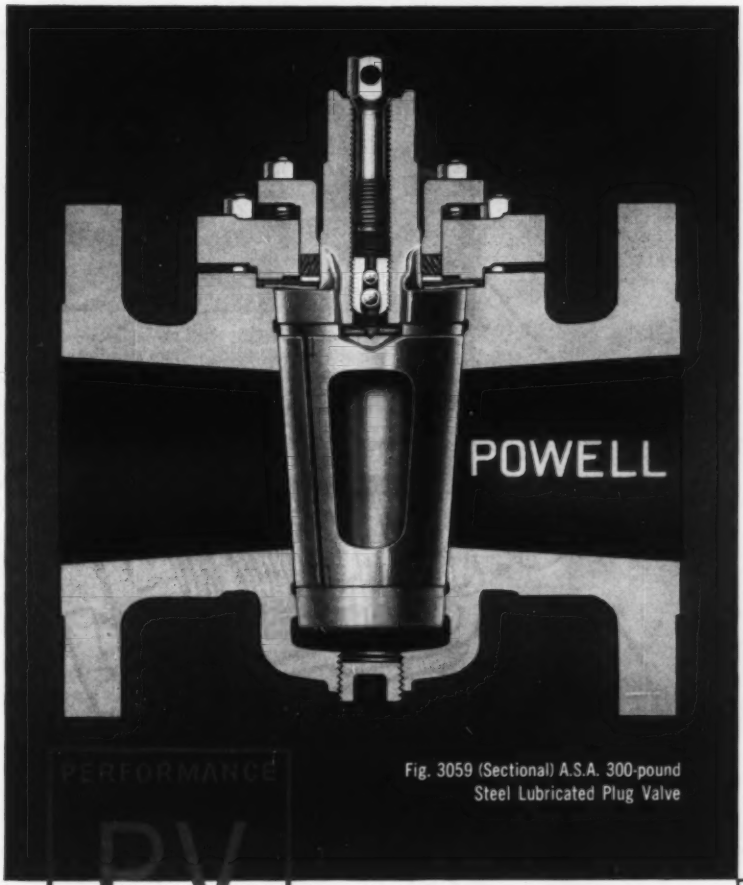


Fig. 3059 (Sectional) A.S.A. 300-pound Steel Lubricated Plug Valve

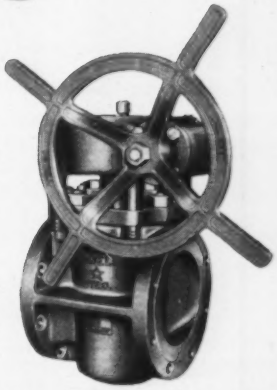


FIG. 1559G—150-pound Steel Lubricated Plug Valve. Gear operated

FIG. 2200—175-pound W.O.G. Semi-Steel Lubricated Plug Valve

PERFORMANCE PV VERIFIED

Powell Lubricated Plug Valves maintain the 110-year tradition of quality and precision. Only the finest available materials are used. And painstaking quality control is rigidly enforced through each and every step of manufacture.

Valve users who want one source of supply for lubricated plug as well as all types of bronze, iron, steel and corrosion-resistant valves will want full details on Powell Lubricated Plug Valves.

For example, features include quick and positive operation—just a quarter-turn to open or close. Lubricant grooves surrounding each port provide a positive seal when the valve is closed. In an open position, seating surfaces are not exposed. Available in Steel and Semi-Steel through distributors in principal cities.

For full details, write for the new PV-4 Catalog on Powell Lubricated Plug Valves. Just fill out the coupon and mail. Of course there's no charge, no obligation.

THE WM. POWELL COMPANY
2525 Spring Grove Ave.
Cincinnati 22, Ohio

Gentlemen:

Please send me a copy of your PV-4 Catalog on Powell Lubricated Plug Valves. It is understood that there is no cost, no obligation.

*name*_____

*title*_____

*company*_____

*city*_____

*zone*_____ *state*_____

The source of supply for all valve needs!

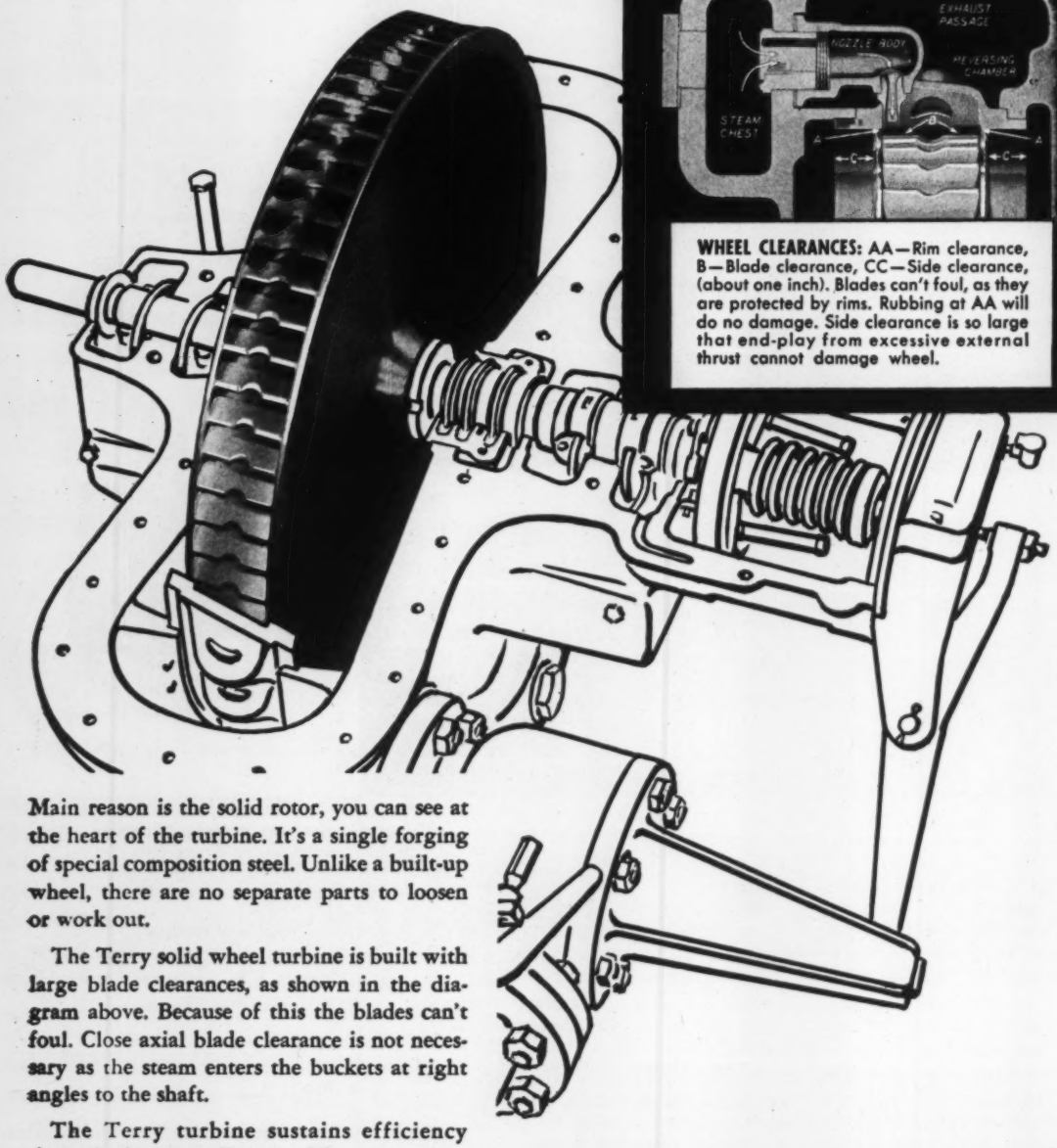
POWELL VALVES...110th YEAR

BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES.

WHY TROUBLE GOES OUT

when this turbine goes in

WHEEL CLEARANCES: AA—Rim clearance, B—Blade clearance, CC—Side clearance, (about one inch). Blades can't foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.



Main reason is the solid rotor, you can see at the heart of the turbine. It's a single forging of special composition steel. Unlike a built-up wheel, there are no separate parts to loosen or work out.

The Terry solid wheel turbine is built with large blade clearances, as shown in the diagram above. Because of this the blades can't foul. Close axial blade clearance is not necessary as the steam enters the buckets at right angles to the shaft.

The Terry turbine sustains efficiency through the years. Reason: The power producing action of the steam takes place on the curved surfaces at the back of the buckets, so blade wear which might occur is of little consequence.

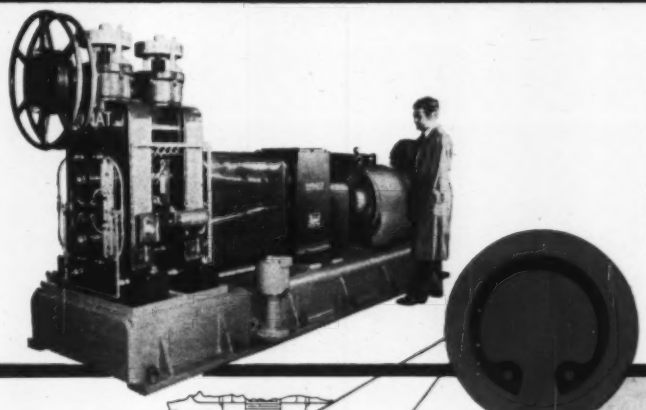
Bulletin S-116 tells more about these *"Work Horses of Industry."* Send for a copy today.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

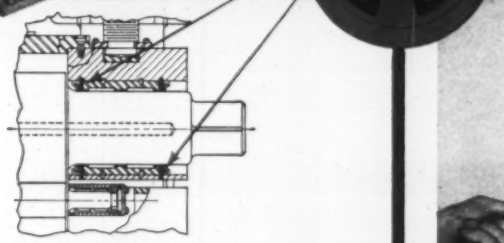
TT-1202

7-inch Waldes Truarc retaining rings cut costs, speed assembly-disassembly of 2-high/4-high mill

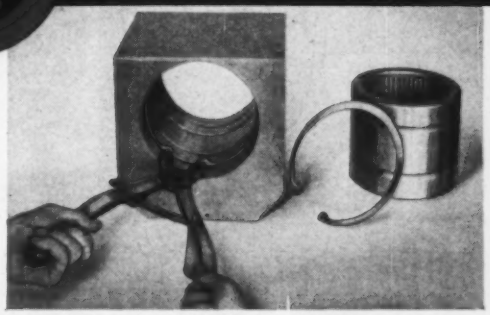


New Model TA-625 2-high/4-high combination rolling mill designed by Stanat Manufacturing Co., Long Island City, N. Y., reduces 2½" ingot to precision-rolled strip as thin as .001".

Waldes Truarc retaining rings help make possible a complete change of work rolls in 20 minutes... solve difficult problems of accuracy control by achieving positive location of bearings to extremely close tolerances. Rings eliminate costly parts and machining, save space, reduce maintenance.



In the assembly illustrated above, 7" Waldes Truarc (Series 5000) retaining rings—three on each roller—are used to position heavy-duty needle bearings in the bearing housing. Smaller rings position bearings in other roller assemblies and retain the shaft of a dual handwheel screwdown. All in all, 18 Waldes Truarc rings are used in the mill. They replace machined shoulders, spacers and lock nuts... eliminate costly threading, other machining operations.



Assembly is simple, even with giant 7" diameter Truarc ring. Special Truarc ratchet pliers grasp the ring securely, ease it into the groove, snap it securely into position. Smaller pliers and various high-speed assembly jigs are available for other rings, permit assembly-disassembly to be performed rapidly even by unskilled labor.

Whatever you make, there's a Waldes Truarc Retaining Ring designed to improve your product... to save you material, machining and labor costs. Quick and easy to assemble and disassemble, they do a better job of holding parts together. Truarc rings are precision-engineered and precision-made, quality controlled from raw material to finished ring.

36 functionally different types... as many as 97 different sizes within a type... 5 metal specifications and 14 different finishes. Truarc rings are available from 90 stocking points throughout the U.S.A. and Canada.

More than 30 engineering-minded factory representatives and 700 field men are available to you on call. Send us your blueprints today... let our Truarc engineers help you solve design, assembly and production problems... without obligation.

For precision internal grooving and undercutting... Waldes Truarc Grooving Tool!

WALDES

TRUARC®

RETAINING RINGS

©1956 Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N.Y.

Waldes Kohinoor, Inc., 47-16 Austel Place, L.I.C. 1, N.Y.
Please send the new supplement No. 1 which brings Truarc Catalog RR 9-52 up to date.
(Please print)

Name _____
Title _____
Company _____
Business Address _____
City _____ *Zone* _____ *State* _____

ME-108

WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787, and other U. S. Patents pending. Equal patent protection established in foreign countries.

announcing

a new line of **small-size easy-to-read** gauges and receivers

NEW **REPUBLIC 5 GAUGES**

Individual, Independent Measuring Units for
DRAFT • PRESSURE AND VACUUM • DIFFERENTIAL PRESSURE • TEMPERATURE
High Accuracy Receivers for Pnuematic Transmitters and Electric Meters Measuring
FLOW • PRESSURE • CO_2 • DENSITY • LIQUID LEVEL • OTHER PROCESS VARIABLES

Important Features

- FIVE INCH ILLUMINATED SCALES
- INDEPENDENT, INTERCHANGEABLE UNITS
- MULTIPLE OR INDIVIDUAL MOUNTING — from one to eight units to a single case
- EASILY MOUNTED — no panel drilling necessary in most cases
- SCALES EASILY CHANGED OR COLOR-CODED
- POINTER MOTION REVERSIBLE
- SIMPLIFIED CONNECTIONS AT BACK OF CASE
- REMOVAL FROM FRONT OR BACK

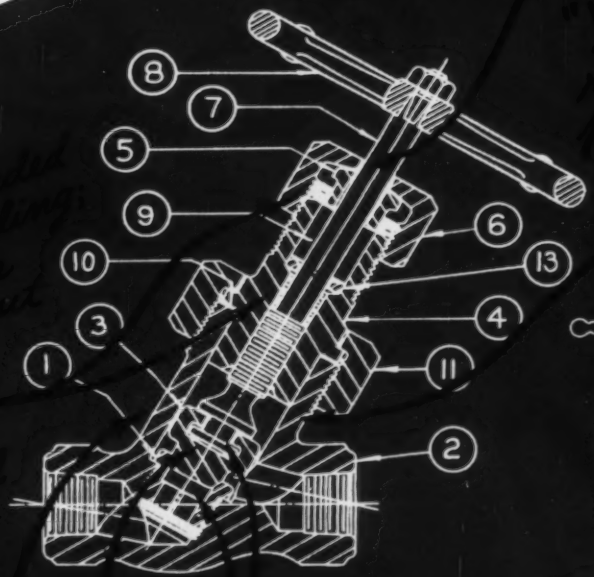
Now you don't have to sacrifice instrument performance and readability to size considerations. With Republic's new line of small-size V5 Gauges, you can save panel space, make more compact instrument groupings and *still* get the accuracy, sensitivity and readability you would expect from conventional sized instruments. Full sized diaphragms, bellows and helix units in V5 Gauges assure "big" gauge performance in an instrument that requires only one-fourth the panel space of conventional gauges. Five inch scales are almost flat and are indirectly illuminated as a standard feature for easy reading — even from a distance.

● ***Write for New V5 Bulletin*** ▶

REPUBLIC FLOW METERS CO.
2240 Diversey Pkwy., Chicago 47, Illinois

R.T.M.
This steel valve with these standard features has an original cost in the bronze valve bracket. S.P.D.

ROCKWELL BUILT
Edward Valves



GLOBE VALVES-SCREWED ENDS FIG. 2698

ANGLE VALVES
SCREWED ENDS—FIG. 2699
SOCKET WELDING ENDS—FIG. 2699Y
EXCEPT FOR BODIES GLOBE & ANGLE VALVES ARE ALIKE

Centerless ground EValloy stem increases packing life; cuts maintenance.

"Y" design reduces pressure drop, turbulence, wear.

EValloy threaded surfaces stop galling; make operation easy throughout valve service life.

All forged steel construction reduces bulk, eliminates porosity.

Solid EValloy stainless stem, seat and disk add years of service to this steel valve.

Vacuum cut on mated seat and disk insure drop-tight closures.

We can save money and cut replacement cost with Edward Fig. 2698 globe and 2699 angle valves. Let's order them.

LIST OF MATERIAL
QUANTITIES ARE FOR 1 GLOBE OR ANGLE VALVE

PIECE Nº	NAME OF PIECE	Nº REQ'D	MATERIAL	SPECIFICATIONS	LIBRARY MS Nº
1	SEAT	1	EVALLOY	A.S.T.M. A182, F6	212
2	BODY	1	FORGED STEEL	A.S.T.M. A105 CLASS II MAX C 0.30%	111
3	DISK	1	EVALLOY	A.S.T.M. A182, F6	212
4	BONNET	1	FORGED STEEL-EVALIZED	A.S.T.M. A105 CLASS II	111
5	GLAND	1	STEEL		123
6	PACKING NUT	1	STEEL-EVALIZED		
7	STEM	1	EVALLOY	A.S.T.M. A182, F6	212
8	HANDWHEEL	1	MALLEABLE IRON	A.S.T.M. A47 GRADE 32510	322
9	PACKING		EVALPAK		501
10	GASKET	1	IRONKOTE (90 BHN MIN)	ARMCO IRON	503
11	UNION RING	1	STEEL	A.S.T.M. A105 CLASS II	111
13	JUNK RING	1	S.A.E. STEEL	EVALIZED	
14	Nº 1 BABBIT CHAIN	1			
15	PADLOCK	1	BRASS		

EDWARD VALVES, INC.
SUBSIDIARY OF ROCKWELL MANUFACTURING CO.
EAST CHICAGO, INDIANA

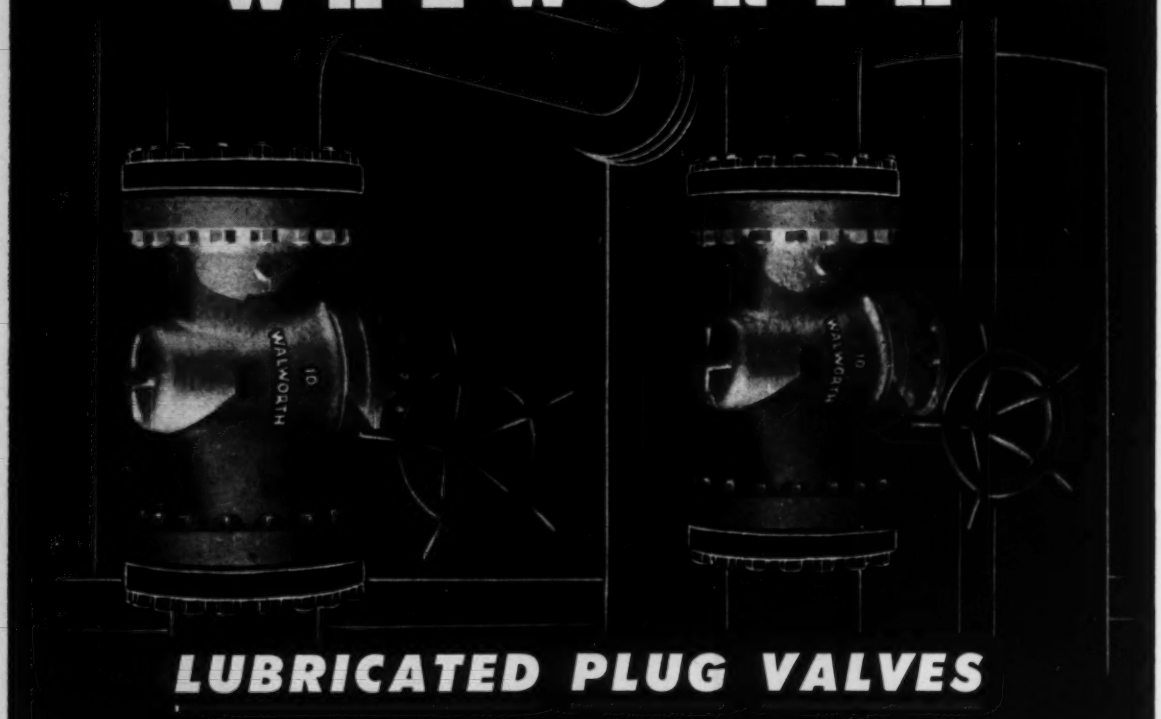
FORGED STEEL 600 LB
GLOBE AND ANGLE VALVES
GENERAL ASSEMBLY

DRAWN: [illegible]
CHK'D: [illegible]
APP'D [illegible] DATE: 12-19-[illegible]

BE-3034-3

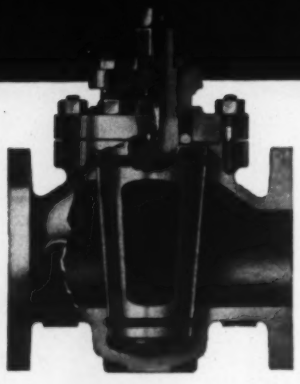
Edward builds Globe and Angle Stop, Non-Return, Check, Stop-Check, Gate, Blow-Off, Mudline, Relief, Hydraulic, Instrument, Gage, and Special Valves and Strainers.

WALWORTH



LUBRICATED PLUG VALVES

Better because... **They are *pressure sealed* with an insoluble lubricant readily renewed while the valve is in service. Lubricant completely surrounds the plug ports assuring a tight seal against leaks. It also insures ease of operation by reducing friction between the body and the plug while at the same time protecting the finished surfaces against corrosion and wear.**



Lubricant system of a Walworth No. 1700F Regular Gland, Wrench Operated, Steel-iron, *Lubricated Plug* Valve. Other Walworth *Lubricated Plug* Valves include Single Gland, and Ball Bearing types. Sizes to 30-inches — pressures to 5,000 psi, and for vacuum service.

Walworth Lubricated Plug Valves are the most satisfactory valves available for the handling of gritty suspensions, and many other destructive, erosive, and corrosive industrial and chemical solutions.

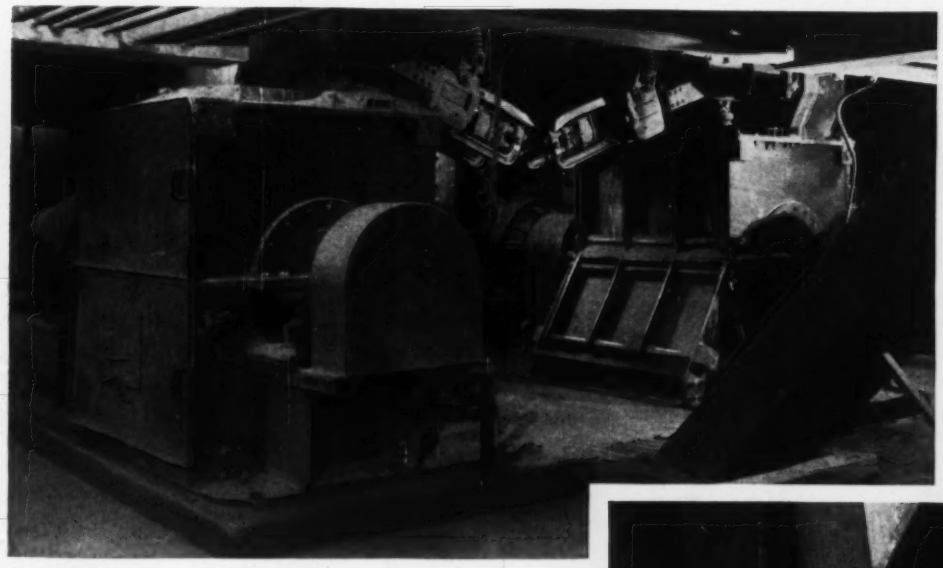
They are ideal for general refinery and pipeline service.

FOR COMPLETE INFORMATION, *SEE YOUR WALWORTH DISTRIBUTOR OR WRITE FOR ILLUSTRATED CIRCULAR*

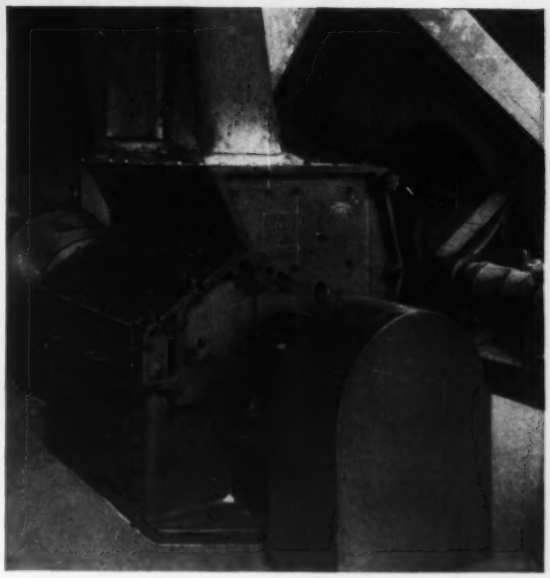
WALWORTH

60 East 42nd Street, New York 17, New York

SUBSIDIARIES: ALLOY STEEL PRODUCTS CO. · CONOFLOW CORPORATION · M & H VALVE & FITTINGS CO. · SOUTHWEST FABRICATING & WELDING CO., INC. · WALWORTH COMPANY OF CANADA, LTD.



Pictured at left and below are Jeffrey Swing Hammer Pulverizers—a popular type crusher in the chemical field. The units at left are fed by Jeffrey vibrating feeders. Jeffrey makes a complete line of auxiliary equipment to handle feed to crushers and dispose of material being discharged from them.



For reduction of every conceivable material

JEFFREY CRUSHERS AND PULVERIZERS

WHETHER the job involves moderate or heavy duty—small or large capacities—there is a Jeffrey crusher exactly suited to produce the right size product in your plant.

Hundreds of Jeffrey crushers and pulverizers daily are successfully reducing scores of different materials in the chemical and allied industries.

Chances are Jeffrey has encountered your crushing problem before and solved it. We have the most extensive test data file maintained by any crusher manufacturer. Or we can run tests on new materials in our laboratory at no cost or obligation to you.

Jeffrey engineers will gladly advise you on your crushing needs. Write to The Jeffrey Manufacturing Company, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

Drafting Department Heads! Now Is the Time to Gear Your Department to Meet Growing Production Demands!

NOW Is the Time to Get Your New, Modern Bruning Copyflex Machine!

Copyflex Model 500—Top mechanical speed of 40 f.p.m., front or rear delivery, automatic separation and stacking, many other features.

The boom in production means more pressure than ever for engineering drawings and prints. Right now is the time to replace that old inadequate reproduction machine you've been putting up with—now's the time to get a modern, efficient Bruning Copyflex.

In just the last year, Bruning has introduced five new, advanced machine models, one of which is shown at the left. These machines offer you the famous problem-free operation of Copyflex . . . no exhaust venting, no plumbing or auxiliary equipment, no installation other than an electrical connection. They bring you faster reproduction speed and a host of operator conveniences such as fast return of originals, automatic separation, front or rear delivery. They are the efficient, economical, modern reproduction machines that will help you boost your drafting room output, keep costs at a minimum.

Now is the time to act. Mail the coupon below. You'll be glad you did!

BRUNING Copyflex

Best Process! Best Machines! Best Selection of Materials!

Specialists in Copying Since 1897

CHARLES BRUNING COMPANY, INC., 4700 MONTROSE AVE., CHICAGO 41, ILL.

In Canada: Charles Bruning Co. (Canada) Ltd., 105 Church St., Toronto 1, Ont.

Charles Bruning Company, Inc., Dept. 103-N
4700 Montrose Ave., Chicago 41, Illinois

Please send me information on Copyflex process and Model 500 machine.

Name_____ **Title**_____

Company_____

Address_____

City_____ **County**_____ **State**_____

. . . you get

21% to 42% MORE ELBOW

for the same cost

When You Use MIDWEST "LONG TANGENT" ELBOWS

ADVANTAGES OF MIDWEST "LONG TANGENT" ELBOWS

- ★ They save pipe.
- ★ They often eliminate short nipples and their extra welds.
- ★ They save time and money in lining up and clamping pipe and fitting.
- ★ They make it easier to apply slip-on flanges.
- ★ They remove the circumferential weld from point of maximum stress and can be sleeved.
- ★ THEY COST NO MORE THAN OTHER ELBOWS.

The long tangents available *only* on Midwest Welding Elbows give you *more fitting for the same price* . . . Midwest "Long Tangent" Elbows cost no more than other elbows. This added length has numerous advantages for the user of welded piping . . . advantages that save money and improve piping. For all the facts, ask the nearest Midwest distributor or write us for Catalog 54.

MIDWEST PIPING COMPANY, INC.

Main Office: 1450 South Second Street, St. Louis 4, Mo.

Plants: St. Louis, Clifton, N.J. and Los Angeles

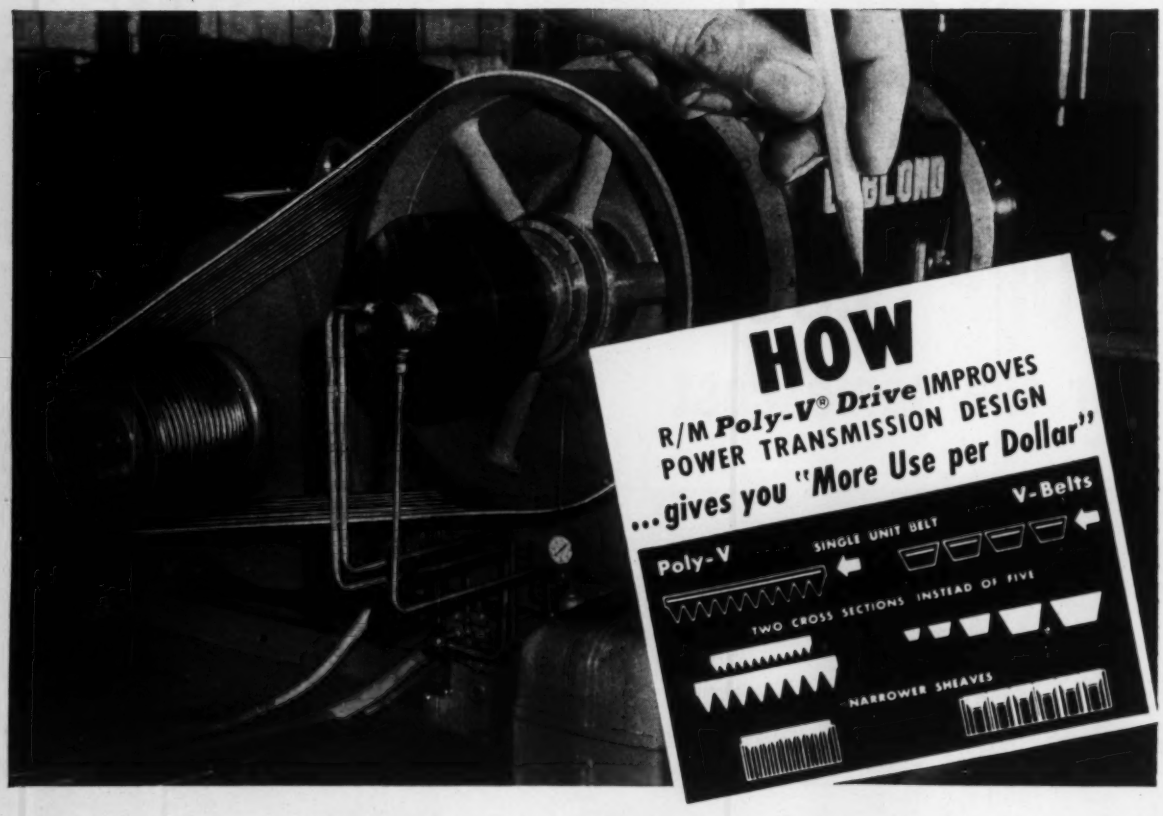
Sales Offices:

New York 7—50 Church St. • Chicago 3—79 West Monroe St. Cleveland 14—616 St. Clair Ave. • Los Angeles 33—520 Anderson St. Houston 2—1213 Capitol Ave. • Tulsa 3—224 Wright Bldg. • Miami 34—2103 Le Jeune Rd. • Boston 27—426 First St. • San Francisco 11—420 Market St.

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS

7324



This *Poly-V® Drive* Saved $2,000 in Machine Cost!

No other belt drive delivers as *much power* in as *little space* as R/M Poly-V Drive. Designers of the giant boring lathe pictured above took advantage of this exclusive Poly-V feature—specified a single unit Poly-V Drive to replace the 13 multiple V-belts previously used on the lathe drive. Results? Sheave width was reduced 30%, eliminating the need for a cumbersome outboard bearing to handle excessive drive weight. . . . This *saved $2000 in the cost of the machine.*

It's another example of why design engineers are calling the patented R/M Poly-V Drive the ideal drive for heavy duty power transmission. Poly-V employs a single, endless V-ribbed belt running on sheaves designed to mate precisely with the belt ribs. You get up to 50% more power in the *same* space as a multiple V-belt drive, or *equal* power in as little as 2/3 the space —with *less* shaft overhang, less drive weight!

Space and weight saving features are just part of the story. There are no belt "matching" problems with Poly-V Drive and just *two* belt cross sections meet every heavy-duty power transmission requirement! Poly-V Drive maintains constant pitch diameter at all loads. Belt speed ratio and belt position are maintained from no load to full load to assure a smoother, cooler running drive . . . reduce belt and sheave wear.

Advantages of this amazing new drive concept add up to improved machine design and real economy—"More Use per Dollar"—for both new and existing equipment. Let R/M engineers work with you on your power transmission problems. Contact an R/M representative . . . or write for Poly-V* Drive Bulletin #6638.

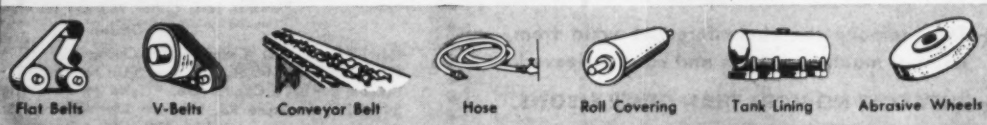
CONDOR V-BELTS • R/M SUPER-POWER V-BELTS

Write for Bulletin #6868 on the complete line of Condor V-Belts for regular service on conventional V-belt drives. Also write for Bulletin #6628 on R/M Super-Power V-Belts with 40% more Horsepower capacity where needed.

*Poly-V is a registered Raybestos-Manhattan Trademark RM-629

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.



Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Laundry Pads and Covers • Bowling Balls

KINNEY Mechanical Booster Vacuum Pump

HYDRECO Gear-Type Fluid Power Pump

Tools to Attain New Horizons in the "Atomic Age" Come From . . .

ENGINEERING "KNOW HOW"

KINNEY MANUFACTURING DIVISION
Boston, Mass.
KINNEY Vacuum Pumps, 0.2 micron, capacity to 5000 cfm; KINNEY Rotating Plunger and Heliquad Liquid Handling Pumps, to 3000 gpm.

VACUUM EQUIPMENT DIVISION
Philadelphia, Pa.
Complete KINNEY Vacuum Systems, Equipment and Components, Vacuum Research and Engineering.

KALAMAZOO DIVISION
Kalamazoo, Mich.
HYDRECO Gear-Type Hydraulic Pumps, 3 to 120 gpm; Fluid Motors, 3 to 52 hp; Cylinders; Control and Auxiliary Valves; 1500 psi. DUDCO Dual-Vane Hydraulic Pumps, 3 to 120 gpm; Fluid Motors, 7 to 140 hp; 2000 psi operation.

WATERTOWN DIVISION
Watertown, N.Y.
Railroad air brake equipment of all types; STRATOPOWER Hydraulic Pumps for Aircraft, to 3000 psi.

AURORA PUMP DIVISION
Aurora, Ill.
Liquid Handling Pumps, AURORA Centrifugals and deep well Turbines, 7000 gpm, 500 ft. heads. APCO Turbine-type 150 gpm, 600 ft. heads. Condensate Return Units.

Modern High Vacuum technology is opening many doors which physicists and scientific researchers now know lead to exciting developments in the future. As dramatic as they are, today's accomplishments are but forerunners of many more to come. To name but a few which had their genesis in Vacuum Processing, there are: Atomic Accelerators, Radar, Transistors and other Electronic Components, TV Tubes, Neon and Incandescent Lighting, Refrigeration and Air Conditioning, "Wonder Metals" Titanium, Zirconium, etc. and the Mycin "Wonder Drugs."

Engineers of The New York Air Brake Company are bringing ever-improved Vacuum Equipment to the scientist in the laboratory and the production engineer in the plant. The KINNEY MFG. and VACUUM EQUIPMENT Divisions of The New York Air Brake Company are the natural sources for the answers to questions and problems involving High Vacuum. Remember the name KINNEY—it's important to those who use Vacuum . . it may well be very important to you!

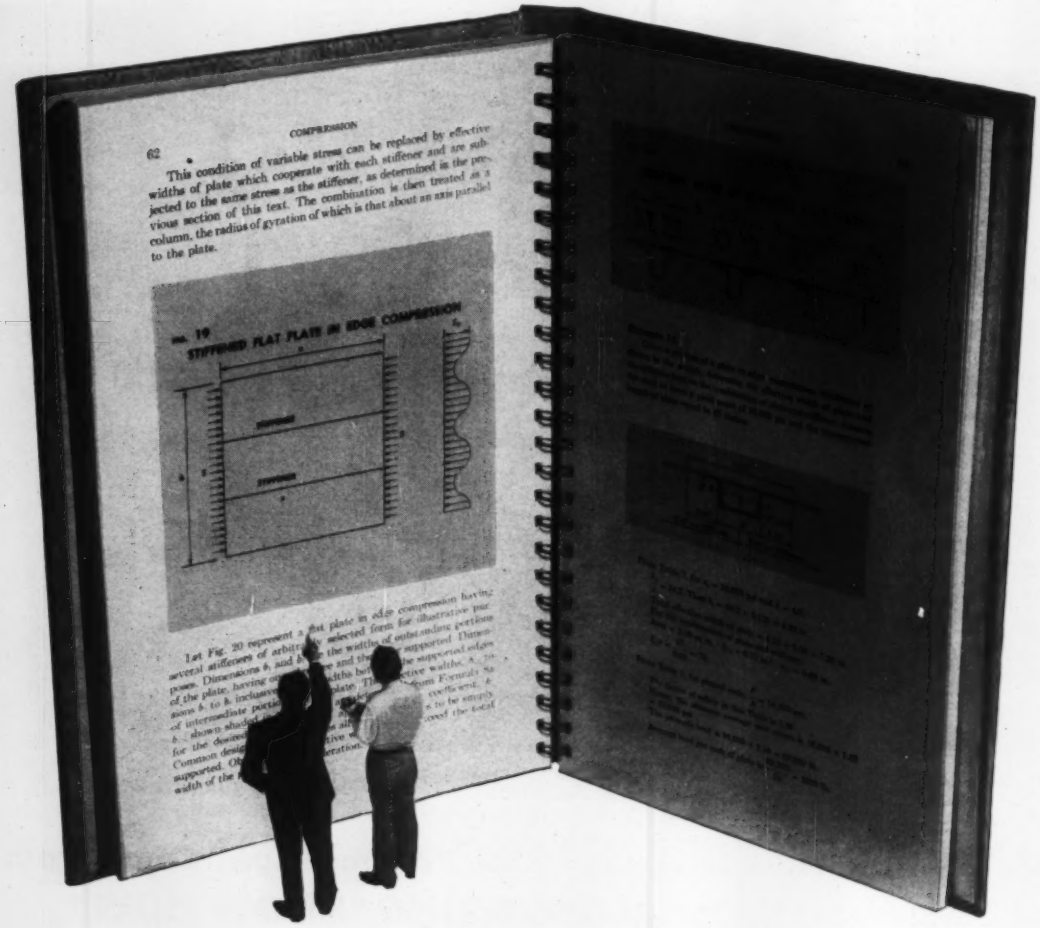
New developments are the norm throughout The New York Air Brake Company. In Hydraulics, HYDRECO and DUDCO Fluid Power components enable builders of Mobile Equipment and Machine Tools to attain higher and higher performance from their equipment. STRATOPOWER Pumps and Fluid Motors, of watch-like precision, help to advance frontiers in the sky in aircraft, guided missiles and rockets. Railroad Air Brakes of new design, bearing the NY mark, are on New York Central's famous Train X.

Write today for literature that will give you an insight into what New York Air Brake's imaginative engineering holds for you.

THE NEW YORK AIR BRAKE COMPANY

230 PARK AVENUE • NEW YORK 17, N. Y.

INTERNATIONAL SALES OFFICE, 90 WEST ST., NEW YORK 6, N.Y.


62 COMPRESSION
This condition of variable stress can be replaced by effective widths of plate which cooperate with each stiffener and are subjected to the same stress as the stiffener, as determined in the previous section of this text. The combination is then treated as a column, the radius of gyration of which is that about an axis parallel to the plate.
FIG. 19 STIFFENED FLAT PLATE IN EDGE COMPRESSION

You'll find it all here . . .

The information you need when designing for high strength steels

OUR new "Design Manual for High Strength Steels" is ready for distribution. Here are 174 pages of practical, authoritative information that you will find invaluable in designing your product for greater economy and efficiency by the sound use of high strength steels. No designer should be without it.

This excellent book covers in detail the problems of tension, compression, shear, beam stress, deformation and deflection. It fully describes the fundamental characteristics of low-alloy high strength steels, shows you how to design against corrosion, describes the application of formed sections. Complete with tables, formulas, and basic data covering this important field of design.

• • •

For your free copy, write on your company letterhead, giving your title or department, to United States Steel Corporation, Room 5466, 525 William Penn Place, Pittsburgh 30, Pa.

UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
NATIONAL TUBE DIVISION, PITTSBURGH • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS HIGH STRENGTH STEELS

USS MAN-TEN • USS COR-TEN • USS TRI-TEN

UNITED STATES STEEL

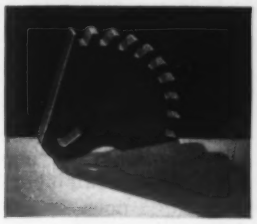
WINZELER NOW STAMPS BETTER GEARING FROM 8 TO 120 DP!

SEE .018 INCH DIAMETER HOLE STAMPED IN MAGNIFIED IMAGE OF .032 INCH FACE, 120 DP BRASS GEAR.

The range of WINZELER *Stamped* Gearing has been increased. You can now get sizes ranging from 8 to *120 dp!* No matter what the size, or whether you need thousands or millions, you can expect the same remarkable accuracy and top quality in *every piece we ship.*

The outstanding success of WINZELER *Stamped* Gearing results from vastly improved methods of Tooling, Stamping, Assembling and Inspection. Mechanisms run smoother, quieter, longer. Production flows faster. Savings, up to 60%, are common. Ask us now about the Gearing you need. Send drawings or descriptions. Ideas, suggestions, low cost estimates do not obligate you. Write TODAY!

ACCURATE, LOW COST STAMPED BAKELITE GEARING



Now, WINZELER successfully *Stamps* and shaves with special tooling, Gearing from BAKELITE material up to 1/8" thick. Sizes, from 8 to 16 dp. Teeth are sharp, clean-cut, uniformly accurate. CUT COSTS. Check up on these tough, quiet, lightweight Gears today.

WINZELER *Stamped Gears*

MAIL THE COUPON FOR FREE STAMPED GEAR FOLDER

WINZELER MANUFACTURING & TOOL CO.,
7355 W. WILSON AVENUE, CHICAGO 31, ILLINOIS

Gentlemen:

Please mail to me, at once, a copy of the free WINZELER Stamped Gear folder.

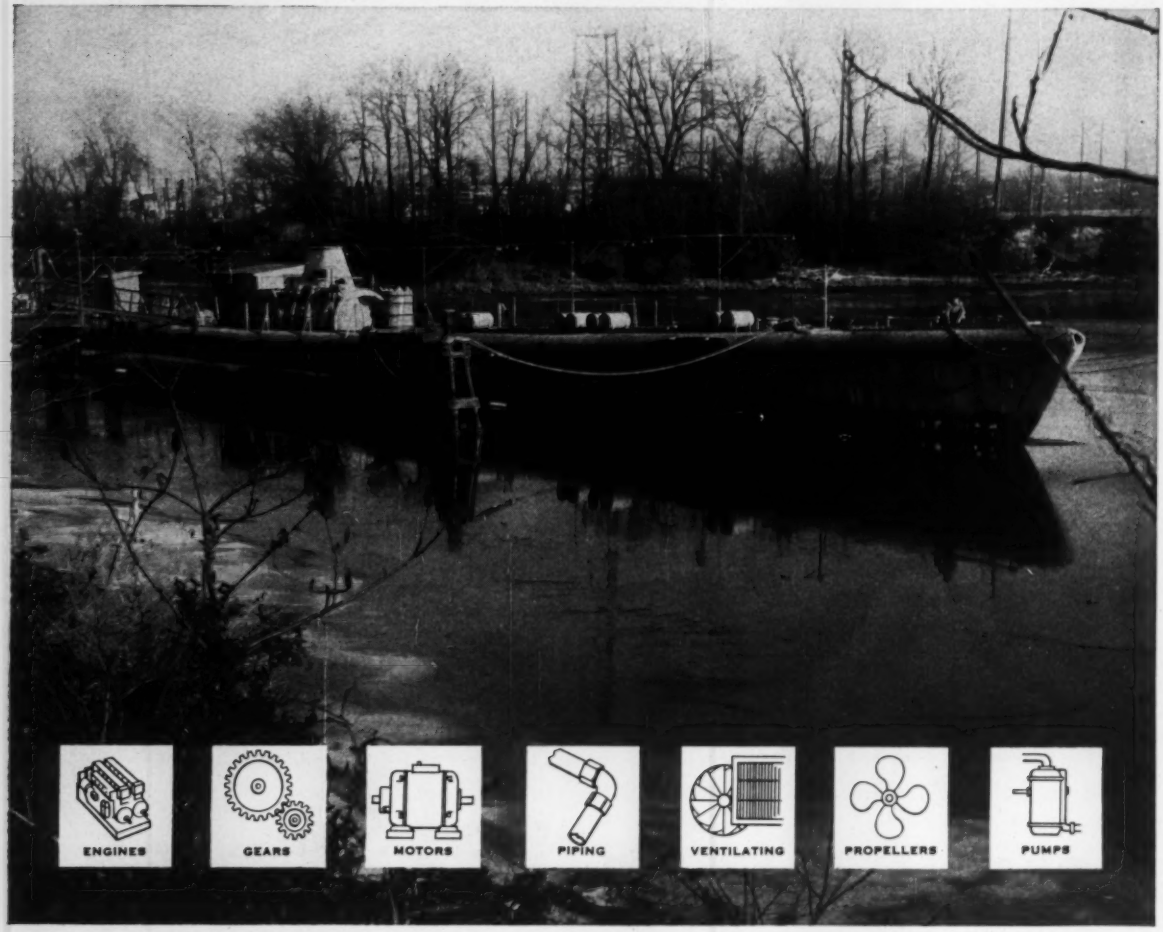
NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

BRUSH...*offers complete systems for noise or vibration measurement*

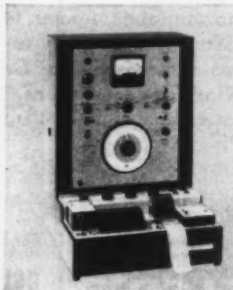


Floating laboratory gets facts on noise to make machinery quieter

In the Navy's experience, a noisy submarine is a dead submarine. Thus, the U. S. Naval Engineering Experimental Station has moored this sub in a quiet spot—and uses it as a test laboratory for noise reduction of machinery and other shipboard equipment.

By recording noise on a Spectrum Recorder, Navy technicians save days of engineering time with automatic analysis and recording of noise amplitude versus frequency. In addition to providing excellent frequency definition, this easy-to-use equipment furnishes a permanent chart record.

For complete information or application assistance on the integrated line of Brush-B & K instruments for sound and vibration measurement systems call your Brush representative, or write Brush Electronics Company.



Third-Octave Spectrum Recorder
key instrument in a complete line for noise and vibration measurements.

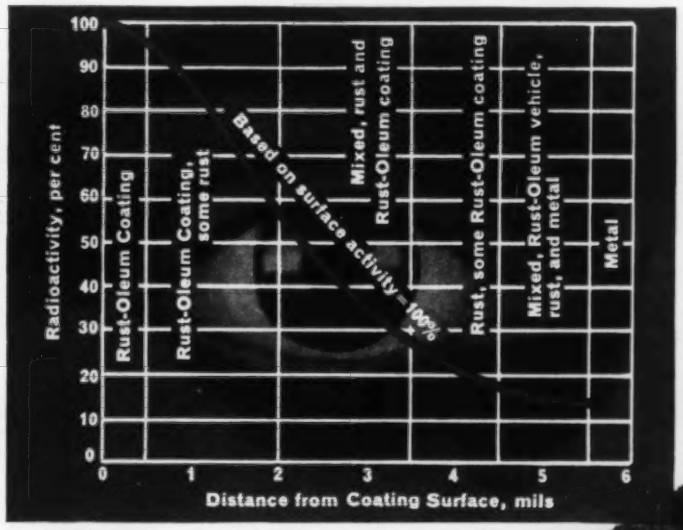
For information write Dept. P-10

BRUSH ELECTRONICS
3405 Perkins Avenue, Cleveland 14, Ohio

BRUSH 6 ELECTRONICS

COMPANY
DIVISION OF
CLEVITE CORPORATION

See Rust-Oleum *penetrate rust* to bare metal through the "Eyes" of Radioactivity!



Curved line illustrates Rust-Oleum penetration through rust at each mil level as recorded by Geiger Counter.

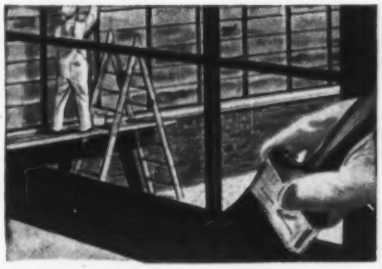
Rust-Oleum dries to a firm, decorative coating that resists salt water, sun, fumes, heat, humidity, and weathering.

Geiger Counter traces Rust-Oleum penetration to bare metal! In nearly three years of radioactive research, Rust-Oleum's *specially-processed* fish oil vehicle was radio-activated and formulated into Rust-Oleum 769 Damp-Proof Red Primer – then applied to rusted test panels. Rust-Oleum's specially-processed fish oil vehicle was then traced through the rust to bare metal by Geiger Counter.

This penetration means rust-stopping power, because the fish oil vehicle works its way into the tiny pits in the metal where it drives out air and moisture that cause rust. Important savings are yours, because Rust-Oleum can be applied directly over sound rusted surfaces – usually eliminating costly surface preparations. Attach coupon to your business letterhead for your copy of the thirty-page report entitled, "The Development of a Method To Determine The Degree of Penetration of a Rust-Oleum Fish-Oil-Based Coating Into Rust On Steel Specimens," prepared by Battelle Memorial Institute technologists. Prompt delivery of Rust-Oleum is assured from your nearby industrial distributor.

There is only one Rust-Oleum. It is distinctive as your own fingerprint.

RUST-OLEUM®



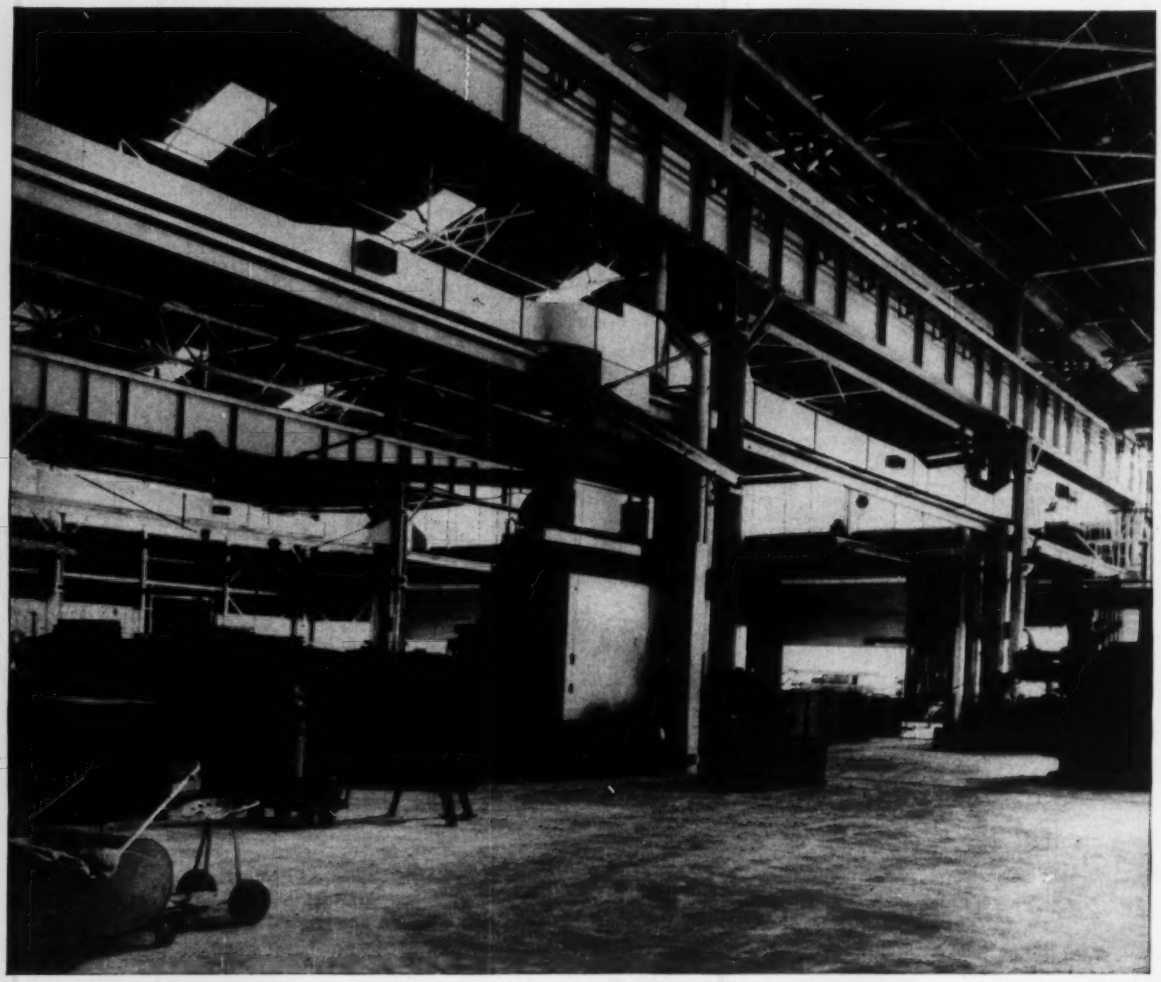
STOPS RUST!

Rust-Oleum is available in practically all colors, including aluminum and white. See our complete catalog in Sweets, or write for information.

ATTACH TO YOUR LETTERHEAD—MAIL TODAY!

Rust-Oleum Corporation
2905 Oakton Street
Evanston, Ill.

- ☐ Complete literature with color charts.
- ☐ Thirty-page report on Rust-Oleum penetration.
- ☐ Nearest source of supply.



Dravo heater supplies warm air as needed in this southern plant.

Dravo heaters provide economical solution to "chilly morning" problem in Texas

Early morning temperatures go below freezing during part of the year in Texas, but as the sun gets higher the thermometer quickly climbs to 75° and higher.

To maintain a constant heat level under these rapidly changing conditions, Oil Well Supply Division of United States Steel Corporation chose Dravo *Counterflo* heaters for their Garland, Texas plant and warehouse. Six 2,000,000 Btu per hour Dravo heaters provide instantaneous transfer of heat from combustion chamber to air stream. This eliminates lag in comfort heating during the chilly morning hours. A thermostat mounted in the return air stream cuts off the fan motor and fuel supply at a predetermined temperature, thus preventing heat-override.

Dravo *Counterflo* heaters are efficient and economical. They require minimum capital investment, minimum installation expenditure, provide low operating costs and there is no need for a full time operator.

Custom engineered Dravo heaters are designed to solve your particular heating problem and save you money at the same time. Why not write for complete information? Address—Dravo Corporation, Machinery Division, Dravo Building, Pittsburgh 22, Pa. Sales representatives in principal cities.

DRAVO
CORPORATION

Blast furnace blowers • boiler and power plants • bridge sub-structures • cab conditioners • docks and unloaders • dredging • fabricated piping foundations • gantry and floating cranes • gas and oil pumping stations • locks and dams • ore and coal bridges • process equipment • pumphouses and intakes • river sand and gravel • sintering plants • slopes, shafts, tunnels • space heaters • steel grating • towboats, barges, river transportation

Idea Sparkers

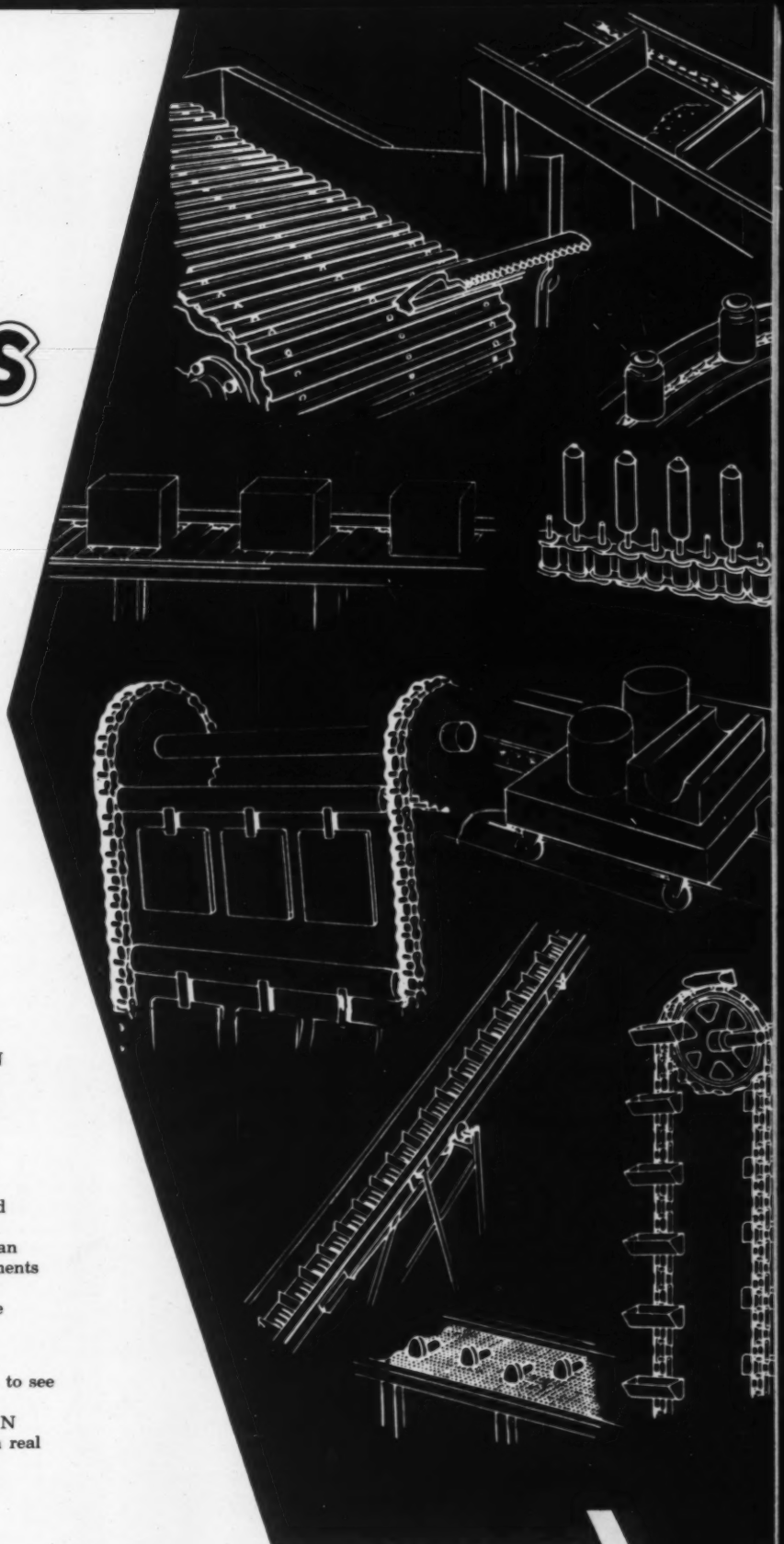
for

MATERIAL HANDLING

Ever been caught "dead center" on design . . . just needing a "spark" to trigger the idea you need to get going again?
Perhaps there's an idea here for you . . . a different use of chains and attachments that might help you find a better, more efficient way to move materials.

For example, in the complete CHAIN Belt line, there are dozens of different types of chain attachments that can be used in hundreds of different ways.
Bars, rods, slats, plates, tripping mechanisms, pins, tabs and many other devices can be simply fastened to chain attachments to perform a multitude of tasks. Many chains can operate as conveyors without attachments . . . using their surfaces as a carrier.
There are virtually no limits to the things you can do with efficient chain and attachments.

We'll be happy to work with you . . . to see if we can come up with an idea that can solve your problems. Your CHAIN Belt District Sales Engineer can be a real help to you, backed by our conveyor chain engineers.



TURN THIS PAGE FOR MORE INFORMATION

CHAIN BELT COMPANY

LEADERSHIP . . . through creative engineering

IDEA SPARKERS *(CONTINUED)*

Why not send for informative literature on conveyor chains and attachments? You'll be amazed at ideas you'll get just from looking over the many attachments you probably never dreamed existed. Just mail the coupon below. There is no obligation.

REX®

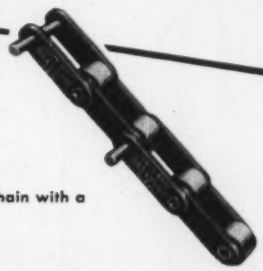
CONVEYOR CHAINS AND ATTACHMENTS

Rex Roller Chain with a K-1 attachment

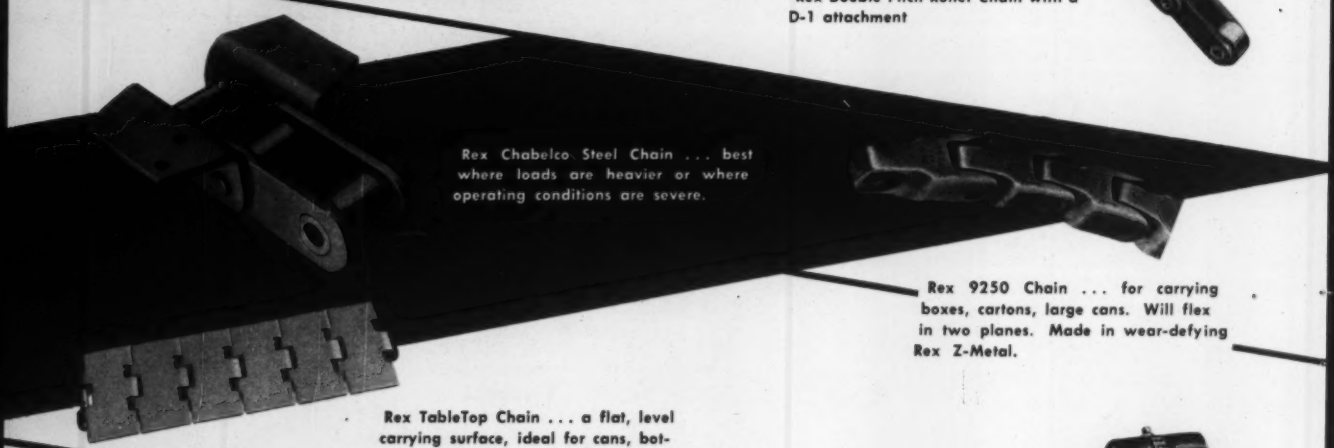
Rex Roller Chain with a D-3 attachment

Rex Roller Chain with an M-3 attachment

Rex Double Pitch Roller Chain with an M-2 attachment



Rex Double Pitch Roller Chain with a D-1 attachment



Rex Chabelco Steel Chain . . . best where loads are heavier or where operating conditions are severe.

Rex 9250 Chain . . . for carrying boxes, cartons, large cans. Will flex in two planes. Made in wear-defying Rex Z-Metal.

Rex TableTop Chain . . . a flat, level carrying surface, ideal for cans, bottles, jars, small parts and packages.

SELF-ALIGNING ROLLER BEARINGS

For effective protection of equipment . . . for longer service life at lower power costs, investigate Shafer Self-Aligning Roller Bearings. Combining all the advantages of ball and roller bearings, these efficient units are your best choice for economical service.

CHAIN Belt Company
Dept. DP-3
Milwaukee 1, Wis.

☐ Send me informative literature on Rex Conveyor Chains and Attachments.

☐ Have my CHAIN Belt District Sales Engineer call.

NAME .....

COMPANY .....

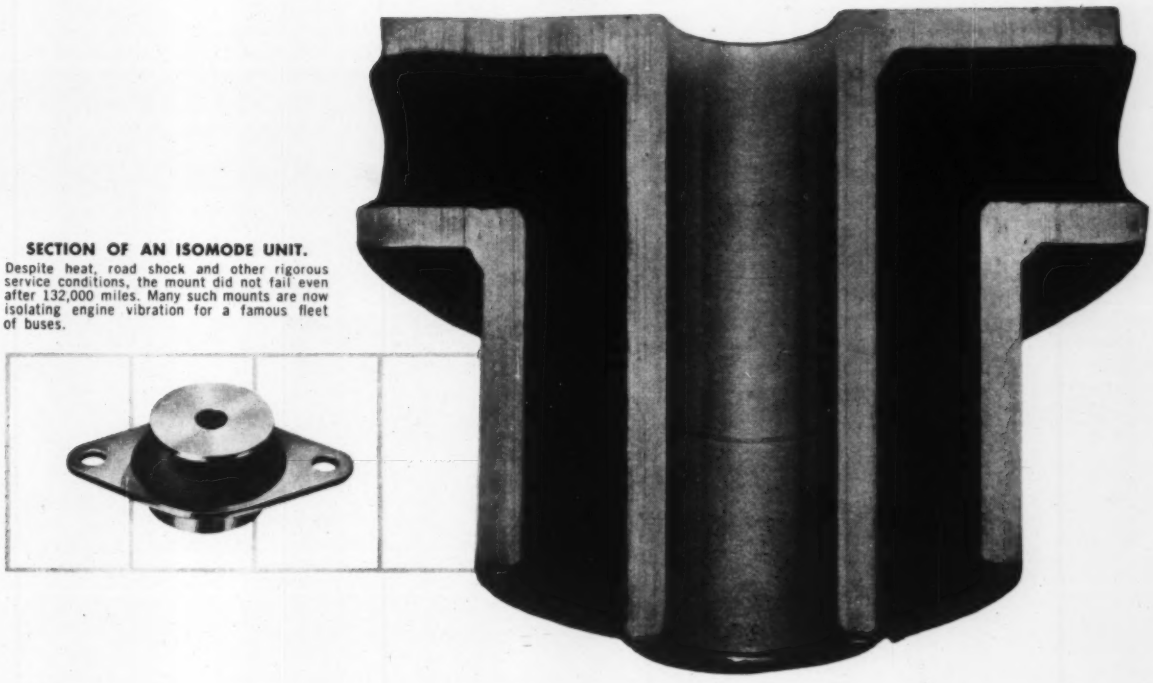
ADDRESS .....

CITY..... ZONE..... STATE.....

CHAIN BELT COMPANY

MILWAUKEE 1, WISCONSIN

MB engine mount proves good for 132000 miles!



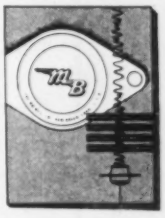
SECTION OF AN ISOMODE UNIT.
Despite heat, road shock and other rigorous service conditions, the mount did not fail even after 132,000 miles. Many such mounts are now isolating engine vibration for a famous fleet of buses.

Above you see a section of an Isomode® type 5 vibration isolator after 132,000 miles of bus service. Breaking an endurance record, the mount could easily have gone to 150,000 miles.

It takes an extremely *rugged* mount to survive the countless road shocks, engine vibration, and stresses of so much travel . . . and still be good for more. As for *performance,* these mounts were originally specified for the well known buses they're in because of *outstanding* vibration isolation.

It's all due to their design . . . the original "Isomode" principle developed by MB over 10 years ago. Cores are in *balanced* compression and shear . . . for the same spring rate in all planes. This controls all modes of motion with equal efficiency, permits mounting at any angle. Note, too, that this design is self-snubbing, preventing excessive motion and damage.

These special-performance, type 5 Isomode units are available as standard parts, with or without mounting ears, for loads of 50 to 2500 pounds. They can also be adapted to your specific needs.



Satisfying difficult vibration control requirements has been MB's business for 17 years. You're welcome to draw on this experience.

Bulletin 616 gives useful data. Send for your copy.

manufacturing company
A Division of Textron Inc.

1060 State Street
New Haven 11, Conn.

HEADQUARTERS FOR PRODUCTS TO ISOLATE VIBRATION . . . TO EXCITE IT . . . TO MEASURE IT.

IMPORTANT DEVELOPMENTS AT JPL

Pioneering in Liquid Propulsion Systems

The Jet Propulsion Laboratory is a stable research and development center located north of Pasadena in the foothills of the San Gabriel mountains. Covering an 80 acre area and employing 1450 people, it is close to attractive residential areas.

The Laboratory is staffed by the California Institute of Technology and develops its many projects in basic research under contract with the U.S. Government.

Opportunities open to qualified engineers. Inquiries now invited.

Development work in liquid propulsion systems began at the Jet Propulsion Laboratory in 1943. This led to the first practical rocket powerplant in the United States in which spontaneous ignition took place upon mixing of the oxidizer and fuel.

This pioneering achievement in the liquid propellant systems opened the way for a vast number of engineering developments in the rocket motor field and in complete missile systems. One of the first applications was to develop motors to assist take-off of aircraft. The next application of the acid-aniline propellant system was to propel the WAC Corporal sounding rocket. This was the first American liquid propellant missile.

The propulsion system used in the Corporal, a mobile surface-to-surface missile system, is of the same basic design. Other successful missiles using the same principle have recently been developed.

Research continues at the Laboratory in the field of chemistry for propellants that will power the missiles of the future. Other activities such as chemical investigations, research and development in the motors, airframes, structures, guidance and all other parts of the missile system are continuously in progress. Stimulating opportunities for individuals desiring a career in the areas of basic and applied research and actual development engineering are now available.

JOB OPPORTUNITIES IN THESE FIELDS NOW

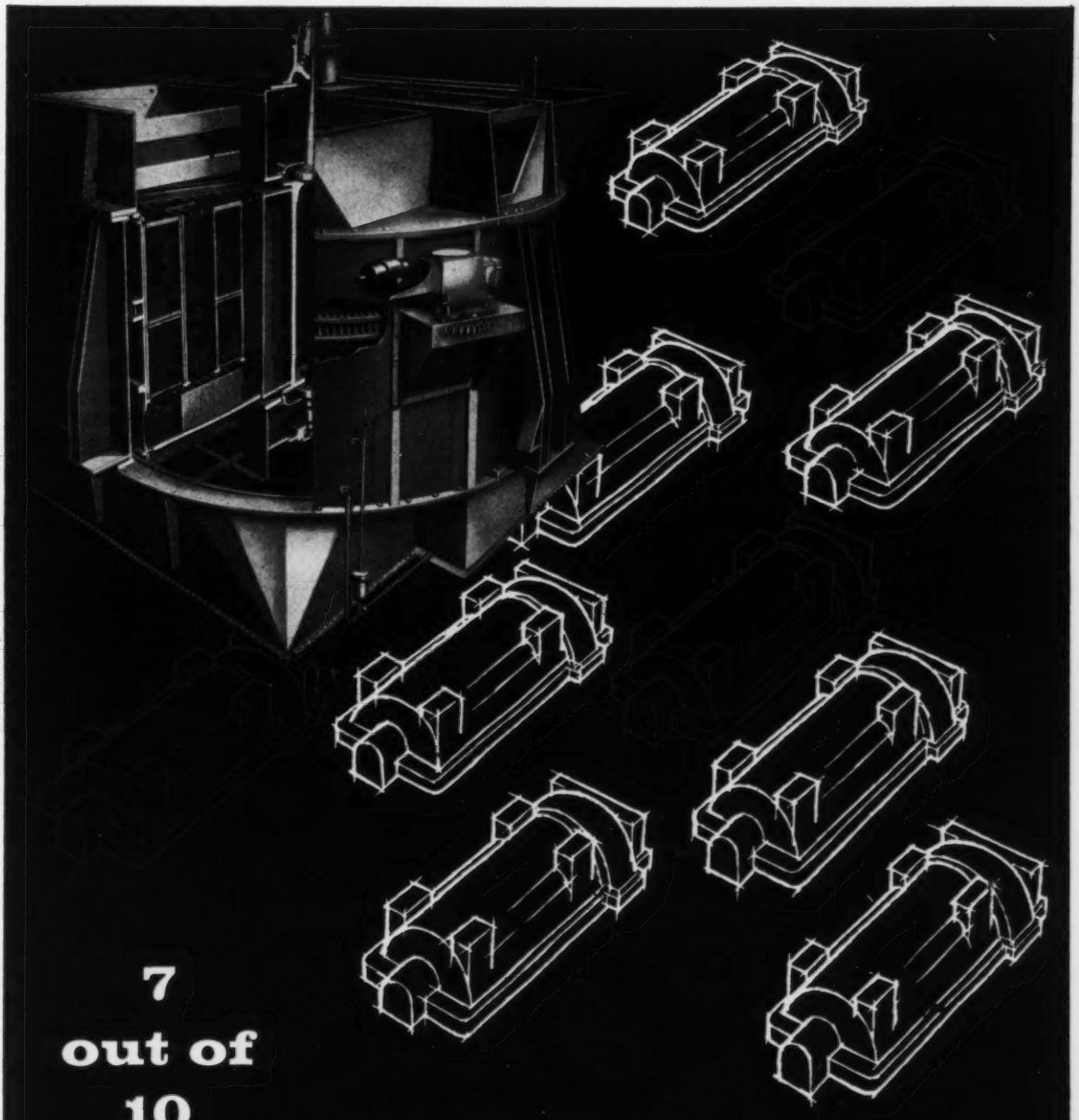
jpl

AERONAUTICS • MECHANICAL • STRUCTURES
DYNAMICS • PROPULSION
APPLIED MECHANICS • INERTIAL ELEMENTS

JET PROPULSION LABORATORY

A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY

PASADENA • CALIFORNIA



7 out of 10

air preheater installations are Ljungstrom®

Advantages of the Ljungstrom Air Preheater

- Size for size, recovers far more heat than any other type.
- Reduces fuel consumption. Permits use of lower grade fuels. Increases boiler output and reliability.
- Eliminates cold spots . . . keeps corrosion to a minimum.
- Easier, faster to clean and maintain.
- Requires far less supporting steel and is quickly erected.

[redacted] is one of the many important reasons. More complete combustion of fuel results in far less slagging, and gases entering dust-recovery units are cleaner. There's less corrosion. Insertion of new elements can be done in as short a time as four hours. You can even inspect the Ljungstrom through a built-in port while the unit is in operation.

For the interesting full story, send for a free copy of our 38-page manual.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

JOHN L. COLLYER

Portrait by Fabian Bachrach

"75% of B. F. Goodrich Employees . . . Save $9,000,000 Per Year"

"B. F. Goodrich people are proud of their many years of participation in the Payroll Savings Plan. 75% of our employees are members of the Plan, with payroll deductions of $9,000,000 a year.

"Thrift is one of the keys to our continued prosperity. It builds security for the family, retards inflation and stabilizes the purchasing power of the dollar. I am proud that Ohio is a leader in this worthwhile endeavor and that it has been my privilege to serve since 1950 as State Chairman of the Payroll Savings Advisory Committee."

JOHN L. COLLYER, ***Chairman***
The B. F. Goodrich Company

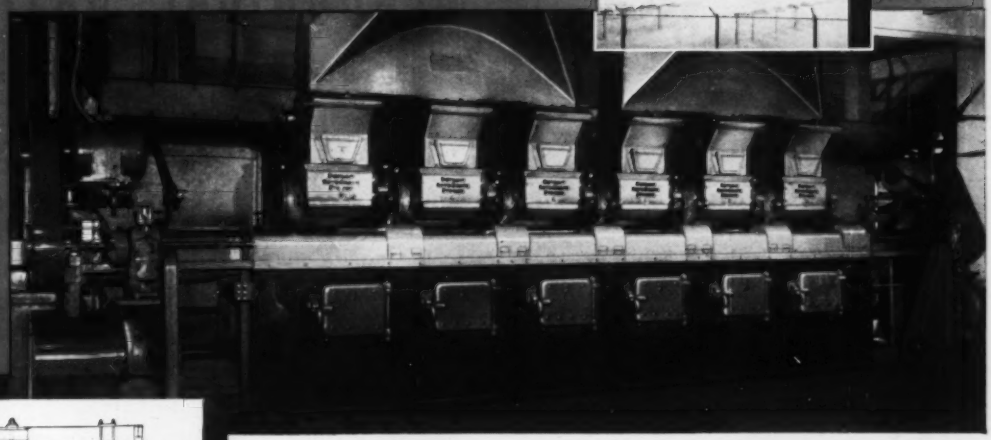
A simple person-to-person canvass that puts a Payroll Savings Application Blank in the hands of *every* employee is all you have to do to install the Payroll Savings Plan or build employee participation in your present plan. Your State Sales Director is ready to help you. Write today to Savings Bond Division, U. S. Treasury Department, Washington 25, D. C.

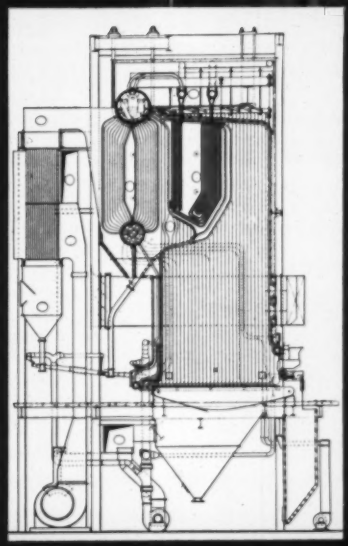
The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

MECHANICAL ENGINEERING

Mile High Plant Steam Generator Fired By DETROIT ROTOGRATE STOKER

Southern Colorado Power Co.





Southern Colorado Power Co.
Canon City, Colorado
W. C. Porter, Vice President in Charge of Operations
Chester Hadley, Superintendent

Stearns-Roger Manufacturing Co., Denver
Engineers—Constructors
Loeb & Esmoe, New York, Consultants

This new unit which triples the capacity of the plant consists of a Babcock and Wilcox two-drum single pass steam generator fired by a Detroit RotoGrate Stoker having six feeders and distributors. The plant is at 5,300 feet above sea level. Capacity of above unit is 150,000 pounds of steam per hour at 860 psi, 915° steam temperature with preheated air at 350° F.

Design is based on bituminous coal:

B.T.U. per lb as fired	10,828
Moisture	8.84%
Volatile matter	33.72%
Fixed Carbon	44.69%
Ash	12.75%
Sulphur (separately determined)	0.7%

However, operation has been completely successful with coal from various mines in the vicinity.

Detroit RotoGrate is an exceptionally efficient spreader stoker with overlapping highly restricted grates that move slowly forward discharging ash at the front. Permits high burning rates with all Bituminous coals, Lignite or refuse fuels. *Write for Bulletin.*

DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

Works at Monroe, Michigan: District Offices in Principal Cities

OTHER TYPES AND SIZES OF DETROIT STOKERS FOR EVERY INDUSTRIAL OR POWER NEED

JUST ISSUED!

THE NEW 1957 MECHANICAL CATALOG

15,000 copies of engineering's most valuable workbook are now ready for you.

This new edition contains:

50,000 listings of over 5095 products

3,500 manufacturers

320 and more pages of detailed drawings, photographs and other specific product data.

Manufacturers are cross-indexed to speed locating everything from absorbers to zinc oxides.

For 46 years, Mechanical Catalog has been the authoritative source of information in the selection of engineered products and has proved to be one of the most valuable ASME services for its members!

If you have not already requested your copy . . .
fill out and mail this coupon now.

Mr. C. E. Davies, *Secretary*

Please send me my copy of the 1957 Mechanical Catalog: I have not previously requested a copy.

Name_____

Title_____

Company_____

Business Address_____

_____

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 WEST 39TH STREET, NEW YORK 18, N. Y.

Bundy Tubing sets new standards for minimum dimensions of return bends

New mass-produced return bends help you solve design problems where space is limited

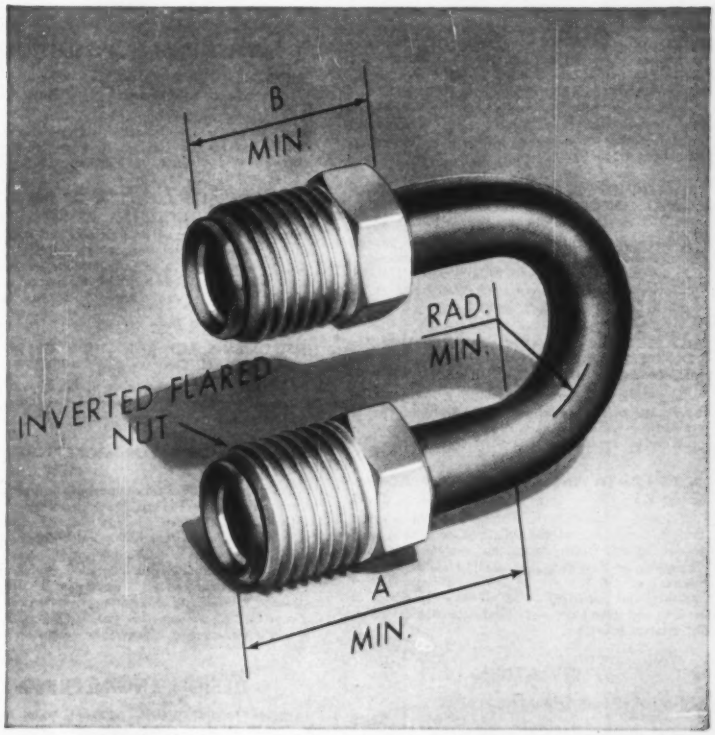
Designers face the unending task of compressing vital equipment into progressively smaller "packages." While helping solve these design problems, Bundy® has established new minimum standards for the mass production of return bends with fittings attached, in tubing from 3/16" to 5/8" O.D.

For example, designing hydraulic actuators for automotive and other uses involves bending tubing to minimum radii, because of severe space limitations. At the request of leading fabricators, Bundy developed the minimum mass-production standards tabulated at right. For special problems, where space is more important than speed of production, Bundyweld® can be fabricated to even closer tolerances.

Bundyweld Tubing takes such fabrication easily because it's the only tubing double-walled from a single metal strip, copper-bonded through 360° of wall contact. The result: stronger, vibration-resistant tubing with high bursting strength and high thermal conductivity. No wonder Bundyweld is the accepted standard of the refrigeration and automotive industries: *it is used in 95% of today's cars, in an average of 20 applications each.*

Add to this, expert, free engineering service, and you know why Bundyweld Tubing solves even the most difficult tubing problems. Call, write, or wire us today!

BUNDY TUBING COMPANY
DETROIT 14, MICHIGAN



TUBE O.D.	3/16	1/4	5/16	3/8	7/16	1/2	5/8
RAD.-MIN.	5/16	3/8	5/8	3/4	7/8	1	1 1/2
A-MIN.	3/4	7/8	1	1 1/16	1 1/8	1 1/4	1 3/8
B-MIN.	5/8	5/8	1 1/16	23/32	3/4	13/16	7/8
Bundy Part No. of S.A.E. St'd Inverted Flared Nut	P-2208	P-2205	P-2206	P-2207	P-2266	P-2267	P-2359

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING. AFFILIATED PLANTS IN AUSTRALIA, ENGLAND, FRANCE, GERMANY, AND ITALY

Bundyweld starts as a single strip of copper-coated steel. Then it's
. . . continuously rolled twice around laterally into a tube of uniform thickness and passed
through a furnace. Copper coating fuses with steel. Result . . .
SIZES UP TO 5/8 O.D.
Bundyweld, double-walled and brazed through 360° of wall contact.

NOTE the exclusive Bundy-developed beveled edges, which afford a smoother joint, absence of bead, and less chance for any leakage.

BUNDYWELD® TUBING

DOUBLE-WALLED FROM A SINGLE STRIP

A Selected List of ASME Reference Tools to Meet Specific Problems

APPLIED MECHANICS

APPLIED MECHANICS REVIEWS. Published monthly
$25.00 Annually ($10.00 to ASME members)

Covering the advances made throughout the world in the fields of applied mechanics and related engineering science, this magazine provides its readers with reliable appraisals of contributions on important investigations, new discoveries in the fields, advanced techniques, and applications of experimental methods—culled from over a thousand sources including 750 engineering periodicals of thirty countries, reports of industrial research laboratories everywhere, and new technical books in all languages. Additionally, each issue contains a feature article by an international authority which reviews and evaluates progress in a specialized area.

PROCEEDINGS OF THE SECOND U. S. NATIONAL CONGRESS OF APPLIED MECHANICS (No discount allowed) $9.00

Offers a unique collection of data, calculation, procedures, and solutions for attacking problems associated with dynamics, vibration, wave motion, elasticity, shells and plates, plasticity, viscoelastic flow, behavior of materials, fluid flow, and aerodynamics.

PROCEEDINGS, 8th (1952) INTERNATIONAL CONGRESS ON THEORETICAL AND APPLIED MECHANICS (No discount allowed) $12.00

The work of approximately 400 contributors in many parts of the world, this 532-page book makes available a wealth of new knowledge on important problems in various areas of applied mechanics.

DESIGN DATA AND METHODS—APPLIED MECHANICS 1953 $4.00

Included in this collection of original and practical contributions are stress and deflection methods applied to circular and rectangular plates; analysis of circular beams; design data for piping; data on springs, thermal stresses, stresses in pressure vessels, shrink-fitted assemblies, and thick-walled cylinders; and methods of treating and solving problems of vibration and of balancing rotating apparatus.

AVIATION

STRUCTURES FOR THERMAL FLIGHT 1956 $3.00

The problem areas herein covered are materials at elevated temperatures, optimum airframe structures, factor of safety concepts, and elevated temperature testing techniques.

CONTENTS: Challenge of Progress. High Speeds Problems of Large Airplanes. Aluminum Alloys for Elevated Temperature Service. Application of a New Structural Index to Compare Titanium Alloys with Other Materials in Airframe Structures. Optimum Stresses of Structural Elements at Elevated Temperatures. Thermostructural Efficiencies of Compression Elements and Materials. Weight Efficiency Analysis of Thin Wing Construction. Design Criteria for Heated Aircraft Structures. Some Structural Penalties Associated with Thermal Flight. Aircraft Structural Testing Techniques at Elevated Temperatures. Some NACA Research on the Effect of Transcient Heating on Aircraft Structures. Utilization of Solar Furnaces in High Temperature Research.

THERMAL BARRIER SYMPOSIUM (In July 1955 ASME Transactions) $1.50

Covers overall problems which arise in pilotless and piloted aircraft, problems associated with the various systems, aspects of structural design and analysis caused by aerodynamic heating and the associate weight penalties.

AUTOMATIC CONTROL

DYNAMIC OF AUTOMATIC CONTROLS 1948 $6.00

Covers the dynamic properties of controllers, the functional elements of a control, mathematical methods for handling control problems, components of the control loop and special control problems, causes of nonlinearities in the control loop, the on-off regulator, and the theory of the excursion-dependent periodic controller.

FREQUENCY RESPONSE 1955 $7.50

Features an unparalleled coverage of automatic control and servomechanism design based on frequency response. To the practicing engineer it brings some of the modern developments in analysis and practice. For the beginner it provides an introduction to typical methods of analysis and synthesis, and acquaints him with representative practical servo systems.

ATMOSPHERIC POLLUTION

SMOG NEWS Published Semi-Monthly (No discount allowed) $6.00 Annually

By direct reproductions of news items, announcements, photographs, and diagrams appearing in the daily press of the U.S. and Canada. This newsletter presents a broad coverage of activities in the air pollution field.

PROBLEMS AND CONTROL OF AIR POLLUTION 1955 $7.50

Presents new material on treatment and recovery of sulphur dioxide, helpful ideas on new developments and control, experiences in air pollution abroad, and much other information useful to those connected with the medical, biological and meteorological aspects of air pollution.

INSTRUMENTS FOR THE STUDY OF ATMOSPHERIC POLLUTION 1956 $2.50

List over a hundred devices useful in studying air pollution together with the names and addresses of the manufacturers who can supply them.

EXAMPLE SECTIONS FOR SMOKE REGULATION ORDINANCE 1949 50¢

Shows how to develop an appropriate ordinance for communities to improve the cleanliness of the air.

CONTENTS: Creation, Organization, and Duties of Smoke Regulation Department. Establishment of Rules and Regulations. Installation and Operating Permits. Inspection. Fees. Emission Prohibited and Standard Measurements. Equipment Dealers. Entrance to Premises. Opportunity of Appeals. Persons Liable. Prosecutions and Clients. Co-ordination of Departments. General Provisions.

DESIGN ENGINEERING

DESIGN ENGINEERING—Training in Value Analysis, Selection of Engineering Materials, Miniaturization Trends, Rewards 1956 $3.50

There is a wealth of information based on actual experience in this book for those interested in the training of design engineers in value analysis, provisions for rewarding them for outstanding achievements, design and selection of engineering materials, and the effect of the trend toward miniaturization.

METALS ENGINEERING-DESIGN 1953 $10.00

It provides criteria for facing the over-all problems of selection of materials, and takes up such specific items as high temperature considerations, elasticity, residual stresses, vibration, fatigue, shot peening, cold working, nitriding, flames strengthening, impact, corrosion, nondestructive testing, surface finish and mass production, and design procedures.

ENGINEERING TABLES 1956 $12.00

A collection of tables often wanted by engineers but are not commonly found in handbooks covering:

Bar Stock and Shafting. Conversion Factors. Formulas for Stress and Strain. Properties of Sections and Cylinders. Bearings. Bearing Load Analysis. Spur Gears. Helical and Herringbone Gears. Bevel Gears. Worm Gears. Cylindrical Fits. Standard Tapers. Keys and Keyseating. Bolts. Counterbores. Screw Threads. Slots. Serrations and Splines. Nuts. Pins. Snaprings. Washers. Wrench Openings. Springs. Aircraft and Mechanical Tubing. Pressure Tubes. Pipe. Pipe Threads and Fittings. Electric Motors. Graphical Symbols. Welding. Gaskets. Hydraulic Standards and Symbols. O-Rings. Packings Seals. Bibliography.

METALS PROPERTIES 1954 $11.00

For each of the more than 500 metals in common industrial use (AISI steels, ASTM steels, cast copper alloys, aluminum alloys, tin, magnesium, etc.), this book gives such information as its chemical composition; brittleness; heat treatment and other characteristics; industrial uses; treatment temperatures for forging, annealing, quenching, etc.; such technological properties as recrystallization temperature and hot working temperature; and a great deal of other pertinent information.

METALS: TEMPERATURE—CUTTING

EFFECT OF TEMPERATURE ON THE BRITTLE BEHAVIOR OF METALS with Particular Reference to Low Temperatures 1954 $7.50 $3.65*

CONTENTS: Evaluation of Brittle Failures in Ships and Engineering Structures. Criteria of Metal Behavior for Design Engineers. Metallurgical and Mechanical Factors. Notched Toughness Test Significance and Reliability. Aspects of Current Research Including New Data on Titanium, Quenched and Tempered Steels at High Strength Levels, and Several Types of Cast Irons.

ELEVATED-TEMPERATURE PROPERTIES OF

Carbon Steels	**1955**	**$3.75**	**$2.80***
Selected Super-Strength Alloys	**1954**	**4.75**	**3.50***
Chromium Molybdenum Steels	**1953**	**4.75**	**3.50***

Each of these reports is a graphical summary of the elevated-temperature strength data collected. Each includes summary curves of tensile and yield strength, elongation and reduction of area, rupture, and creep rates; also data sheets giving the chemical composition, processing data, heat treatment, and other pertinent information about the steels included in the respective surveys.

***Prices to ASME members.**

MANUAL ON CUTTING OF METALS 1952 $10.00

Treats the mechanical characteristics and structures of the metals to be cut—irons and steels, high nickel alloys, copper and its alloys, magnesium, and plastics; explains the influence of the composition and micro-structure of each metal on the wear of the cutting tool, chip formation and control, and surface finish; deals with cutting fluids and the cutting speeds for specific cutting conditions when turning a variety of metals; includes drawings of tool shapes, and 330 tables giving data on feeds and speeds.

TERMINOLOGY

AUTOMATIC CONTROL TERMINOLOGY (ASME Standard No. 105) 1954 $1.50

Terms defined herein apply principally in the field of automatic control in industrial processes. Diagrams illustrate the intent of the definitions.

CONTENTS: Automatic Controllers. Basic Characteristics. Processes, Their Elements and Characteristics. Characteristics of Automatic Control. Types of Automatic Controller Action. Adjustments of Automatic Controller Action. Elements and Characteristics of Automatic Controllers. Basic Terms. Block Diagrams, Symbols, and Automatic Control Combinations.

INDUSTRIAL ENGINEERING TERMINOLOGY (ASME Standard No. 106) 1955 $1.50

Lists and defines approximately 500 terms used by industrial and management engineers. Subjects range from elementary definitions to an entire series of complex production terms.

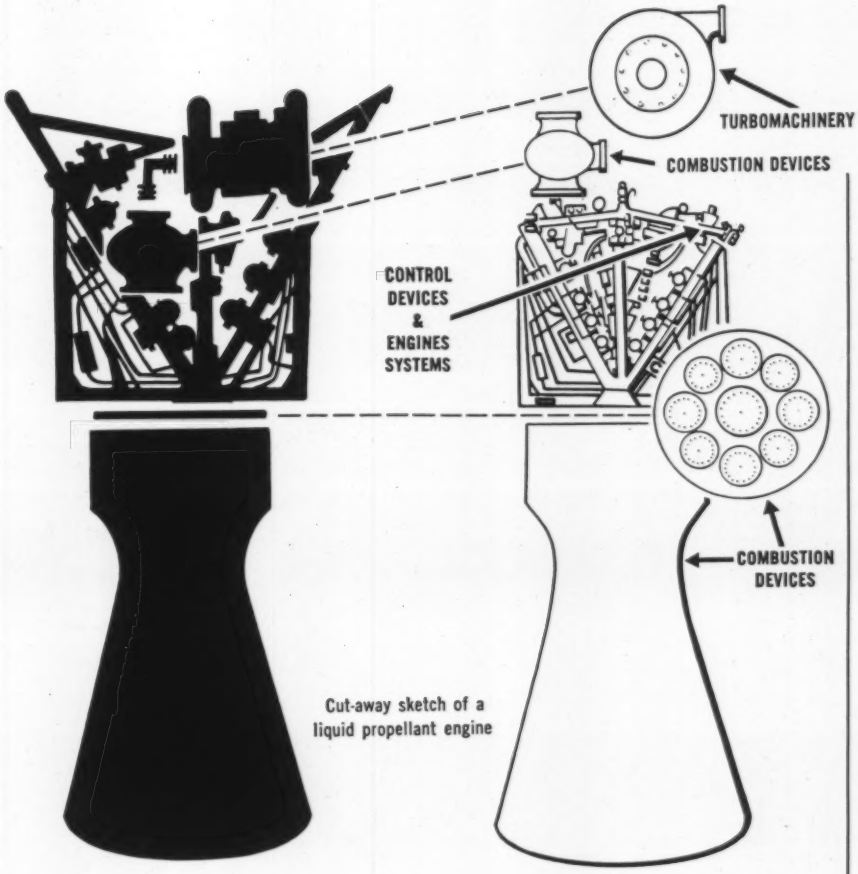
GLOSSARY OF TERMS IN NUCLEAR SCIENCE AND TECHNOLOGY 1955 $5.00

This glossary of terms clarifies today's nuclear language, contributes to the standardization of usage, and provides scientists and engineers with a minor compendium of nuclear knowledge. Terms and definitions are alphabetically arranged and include those used in Physics, Reactor Theory, Reactor Engineering, Chemistry, Chemical Engineering, Biophysics, Radiobiology, Instrumentation, Isotopes Separation, and Metallurgy.

20% Discount to ASME Members
Except where stated "No discount allowed"

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 W. 39th St., New York 18, N. Y.



Cut-away sketch of a liquid propellant engine

R & D Engineers: can you fit into this picture?

Chances are that one of the areas of engineering listed at the right will fit you like a glove! All you need be is a research, development or design engineer with a desire for challenging work and pertinent background experience.

ROCKETDYNE needs men with special talents to help design and develop rocket engines for long-range and intercontinental missiles. Its Propulsion Field Laboratory – located on a 1700-acre site in the Santa Susana Mountains a few miles west of Los Angeles, California – is the largest rocket engine testing facility in the Free World. Here, and also at our new design, development and engineering facility in Canoga Park, you will find the rewards of leadership – good salary, personal and professional recognition, exciting work and secure future. ROCKETDYNE offers many different areas of opportunity. For example: as an Engines System engineer at ROCKETDYNE, you may direct construction on full-scale mock-ups of engine assemblies. You may design laboratory testing machinery to evaluate engine components or Ground Handling Systems and packaging for complete engines. You may be responsible for the programming of engine testing schedules and the preparation of specifications for instrument procedures. Or, you may be responsible for evaluating engine test data in terms of overall engine development. At ROCKETDYNE you can go as far as your abilities can carry you. Check these ROCKETDYNE opportunities today!

Turbomachinery
Thermodynamics
Hydrodynamics
(Centrifugal & axial flow pumps)
Stress Analysis
Mechanical Design –
for high speed turbines, pumps, gearing, bearings, rotating seals.

Combustion Devices
Thermodynamics
Heat Transfer
Hydrodynamics
Combustion Mechanics
Ignition
High Temperature Design
High Pressure Design

Control Devices
Servo Systems
Pneumatic Design
Hydraulic Design
Combustion System
Fuel Start Systems

Engine Systems
Engine Installation
Systems Design
Structural Design
Pneumatic Systems
Hydraulic Systems

Several select positions are also available for analytical and theoretical engineers in the following activities (which are concerned with the complete rocket engine):

APPLIED MECHANICS – Senior dynamicists and stress analysts with advanced abilities.

SYSTEMS ANALYSIS – for performance and numerical analysis, and reliability. Also design analysis involving complex systems engineering concepts combining gas dynamics, heat transfer, thermodynamics and fluid flow.

Write to A. W. Jamieson,
Rocketdyne Engineering
Personnel Dept. ME
6633 Canoga Avenue,
Canoga Park, California

Please send me a copy of "The Big Challenge" – fact-filled booklet explaining rocket engines and engineering.

Name_____

Home Address_____

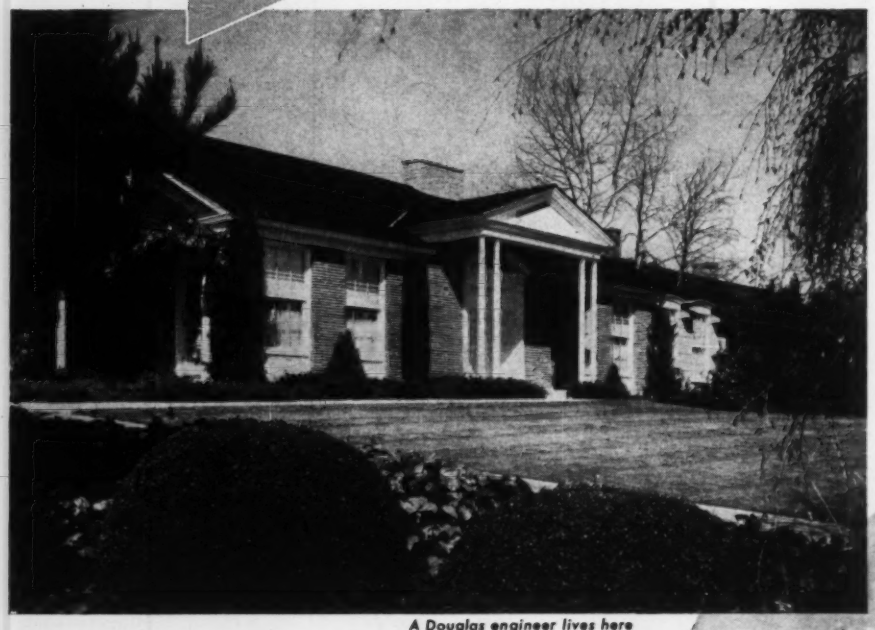
Degree_____ Year_____

School_____

ROCKETDYNE
A Division of North American Aviation, Inc.

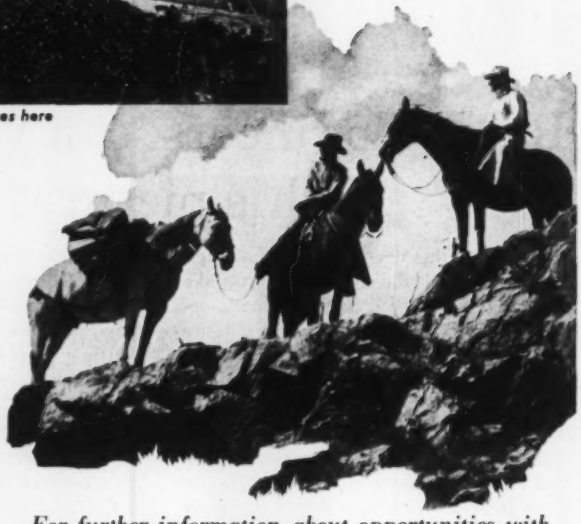
BUILDERS OF POWER FOR OUTER SPACE

Engineers... Look ten years ahead!



A Douglas engineer lives here

Will your income and location allow you to live in a home like this... spend your leisure time like this?



They can...if you start your Douglas career now!

Douglas has many things to offer the career-minded engineer!

...there's the stimulating daily contacts with men who have designed and built some of the world's finest aircraft and missiles!

...there's enough scope to the Douglas operation so a man can select the kind of work he likes best!

...there's security in the company's $2 Billion backlog of military and commercial contracts!

...and there's every prospect that in 10 years you'll be where you want to be professionally, and you'll be in both the income level and geographical location to enjoy life to its full.

For further information about opportunities with Douglas in Santa Monica, El Segundo and Long Beach, California and Tulsa, Oklahoma, write today to:

DOUGLAS AIRCRAFT COMPANY, INC.
C. C. LaVene, 3000 Ocean Park Blvd.
Santa Monica, California

DOUGLAS **First in Aviation**

WHAT TO LOOK FOR IN A HIGH PRESSURE-HIGH TEMPERATURE STEAM TRAP....

High pressure—high temperature service is no place to cut corners, no place to to take chances. Here are some things to think about in specifying steam traps:

1. Experience—Since right after World War One, Armstrong trap development has kept pace with the trend to higher and higher pressures and temperatures. These traps are the most widely used of any in leading power plants throughout the world at pressures up to 2400 psig—there is no finer endorsement.

2. Design—The simple, dependable Armstrong inverted bucket mechanism provides the closest thing possible to 100% assurance that the trap will not fail to open for condensate and close for steam. Extra heavy forgings provide large safety margins.

3. Materials—see list at left.

4. Price—Armstrong forged steel trap list prices range from $95 to over $1000. The No. 515 shown above is rated for 1500 psig at 900°F and for 2000 psig at 600°F. It lists at $500. Armstrong prices are moderate for what you get because of high production. *There is no compromise made at the expense of safety, quality and low maintenance.*

Want more facts?—Call your local Armstrong Representative or write: Armstrong Machine Works, 812 Maple Street, Three Rivers, Michigan.

Do you have Catalog J?—This 44-page Steam Trap Book is free on request.

ARMSTRONG MACHINE WORKS
894 Maple Street • Three Rivers, Michigan

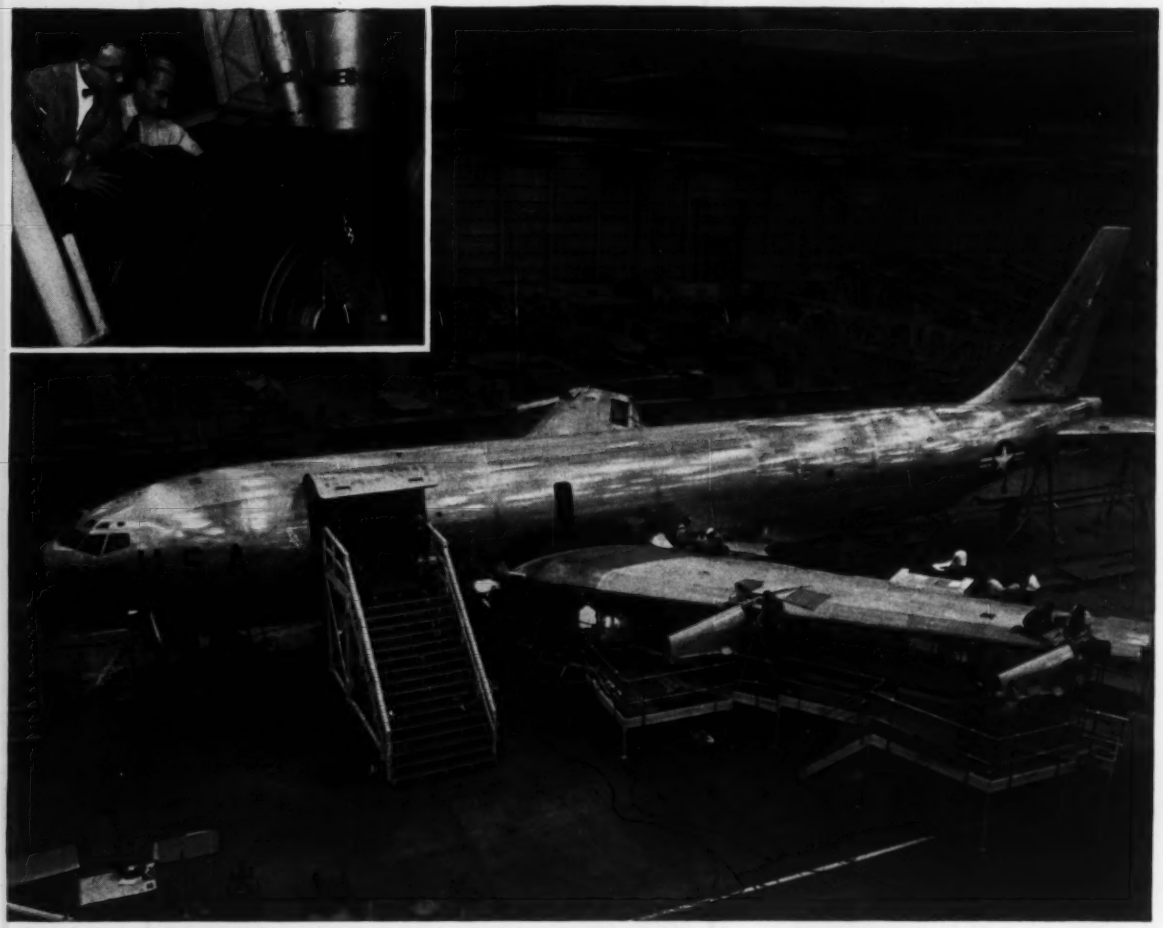
LIST OF MATERIALS

ARMSTRONG FORGED STEEL TRAPS

Part	Material
CAP AND BODY FORGINGS	
Up to 600 psi, 750°	1030 carbon steel
Up to 900 psi, 900°	ASTM Spec. F-1 carbon moly steel
Up to 2500 psi, above 900°	ASTM Spec. F-5 chrome moly steel
VALVE AND SEAT	Type 440 chrome steel, heat treated, standard. Stellite available.
LEVER MECHANISM	Stainless steel
BUCKET	Stainless steel
BOLTS	Class C high tensile, high temperature bolting material—125,000 min. tensile.
NUTS	Hex, semi-finish, heat treated for high pressure, high temperature service.
GASKET	Compressed graphited asbestos
INLET TUBE	Wrought iron

STEAM TRAPS FOR EVERY REQUIREMENT — APPLICATION ENGINEERED

ARMSTRONG STEAM TRAPS



Another engineering first—the Boeing jet transport-tanker

The KC-135, shown on the production lines of Boeing's Transport Division, is America's *first* jet transport-tanker. It gives the Air Force a refueling craft that matches the performance of today's jet-age fighters and bombers. In its transport role, the KC-135 becomes our defense forces' first aerial carrier with the speed and altitude for jet-speed operations.

Mechanical engineers at Boeing—who helped turn out 888 propeller-driven tankers in this same plant—are now working full time on jet-powered aircraft. Boeing's big and growing backlog of orders creates openings-with-a-future for many more mechanical engineers.

Mechanical engineers at Boeing enjoy a great variety of production assignments: in tool design, industrial engineering, liaison, test equipment and other fields. They pioneer methods of fabricating new materials. They supervise the development, checking and control of production processes. Besides the KC-135, mechanical engineers helped produce other advanced Boeing aircraft: the B-52 eight-jet intercontinental bomber and the 707, America's *first* jet airliner.

Here's some measure of your advancement potential at Boeing: during the last 10 years, the number of Boeing engineers has increased 400%. With that kind of growth, there are always opportunities for advancement. They could be *your* opportunities, for Boeing promotes from within. Every six months a merit review gives you an occasion for recognition, advancement, increased income.

At Boeing, you live in progressive, young-spirited communities, with good housing and recreational activities. You work with men outstanding in the world of engineering, on projects of tremendous importance to your country. You look forward to one of the most liberal retirement plans in the industry. There's job stability, and a limitless future, at Boeing—in production, and in design and research as well. If this is what you're looking for, get started by mailing the coupon—today!

JOHN C. SANDERS, Staff Engineer—Personnel
Boeing Airplane Co., Dept. F-56, Seattle 24, Wash.

F. B. WALLACE, Staff Engineer—Personnel
Boeing Airplane Co., Dept. F-56, Wichita, Kansas

A. J. BERRYMAN, Manager—Administration
Boeing Airplane Co., Dept. F-56, Melbourne, Fla.

Mail this coupon to the address above from which you desire further information about advantages of a Boeing career.

Name _____

College(s) _____ Degree(s) ____ Year(s) ____

Address _____

City _____ Zone ____ State _____

Telephone number _____

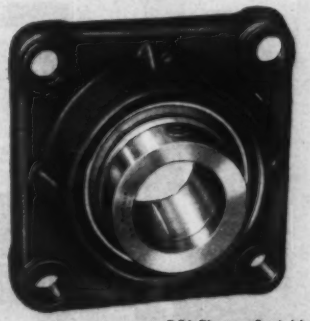
BOEING

Aviation leadership since 1916

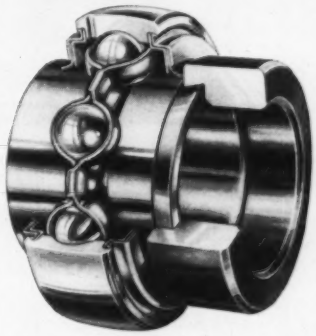
SEATTLE, WASHINGTON WICHITA, KANSAS
MELBOURNE, FLORIDA

NEW! Fafnir Wide Inner Ring Ball Bearings with PLYA-SEALS . . . *contact type*

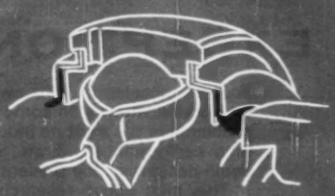
A most important feature
. . . on slow-speed applications where service conditions are excessively dirty and moist



RCJ Flange Cartridges
(Standard Series)



RAK, RAS Pillow Blocks
(Standard Series)



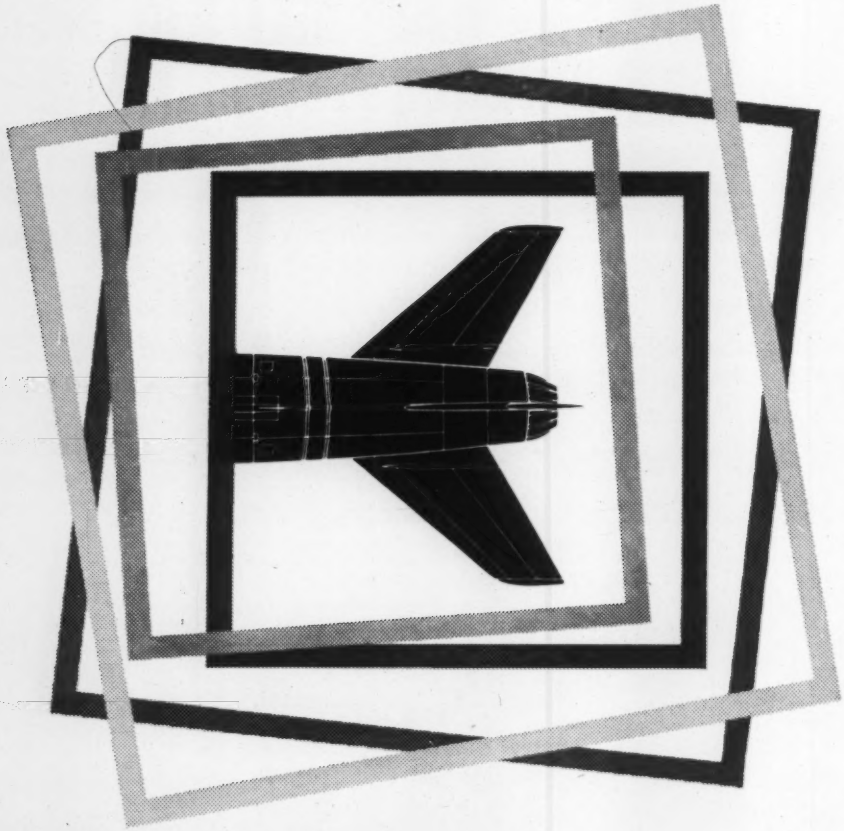
Plya-Seal Construction
— for wide inner ring ball bearings. A synthetic rubber, contact-type seal located between two "dished" steel plates for extra rugged support.

With the addition of this version of PLYA-SEALS to the Fafnir line of wide inner ring ball bearings, you can be more selective in the type of sealed bearing you specify and install. Where service at slow to moderate speeds demands most effective protection against contaminants, especially air-borne dust, dirt and grit, the Plya-Seal type offers the advantages of contact seals, tested and proven by years of service.

Plya-Seal Wide Inner Ring Bearings are optional on the standard series Pillow Blocks and Flange Cartridges. They are dimensionally interchangeable with the Fafnir Mechani-Seal. Flared lip and clearance between inner supporting seal member and inner ring O.D. keeps seal from pushing in. Plya-Seals do not absorb contaminants, thus their surface won't glaze and lose its efficiency. *Fafnir Wide Inner Ring Bearings equipped with Plya-Seals are relubricatable!*

Here's an opportunity to improve operations, reduce servicing, eliminate loss of lubricant, provide the most effective protection from contaminants. For new Bulletin on Plya-Seal Wide Inner Ring Ball Bearings, ask your Authorized Fafnir Distributor or write The Fafnir Bearing Co., New Britain, Conn.

FAFNIR
BALL BEARINGS
MOST COMPLETE LINE IN AMERICA



NEW DEVELOPMENTS in flutter, vibration, electronics, many other specialized fields:

EXCEPTIONAL OPPORTUNITIES NOW

You can accelerate your own career considerably by working with us on some of the most advanced problems in the aviation industry—the problems of high performance aircraft, supersonic and hypersonic designs of the present and the future.

This high speed research includes design and test in Vibration, Aeroelastic and Flutter analyses, analog and digital computer techniques in Electronics, and many more.

The opportunities at North American, Los Angeles Division, are many and varied. You work surrounded by activities of a highly interesting nature, using facilities of the most advanced type. You'll enjoy wide scope for your talents, and you'll particularly like the climate of individualism and team spirit that exists. Your associates will be people who respect your opinions and professional status. Check the openings listed below.

OPENINGS ARE IMMEDIATE. PROFESSIONALLY QUALIFIED WOMEN ARE WELCOME

Recent Aeronautical Engineering Graduates • Recent Mathematics Graduates (Women) • M. E. Graduates with Vibration Experience • Recent Electrical Graduates, for Lab. work • Experienced Flutter Engineers (Aeronautical, Mechanical Engineers, Physicists, Mathematicians) • Experienced Vibrations Engineers • Experienced Instrumentation Engineers, electrical background • Experienced Analog or Digital Computer Engineers, either Electrical, Mechanical or Aeronautical Engineers, or Physicists. Heavy analog experience desirable.

ALSO NEEDED: Aerodynamicists, Systems Engineers, Instrumentation Engineers, Aero-Thermodynamicists, Aeroelastic Engineers, Cycle Analysis Engineers

Contact Les Stevenson, Engineering Personnel Office, Dept. 56-10 ME
North American Aviation, Inc., Los Angeles 45, California

North American Aviation, Inc. is doing research and development on the X-15, a manned aircraft for investigation of speeds and temperatures at very high altitudes.

Los Angeles Division

NORTH AMERICAN AVIATION, INC.

NORTH AMERICAN HAS BUILT MORE AIRPLANES THAN ANY OTHER COMPANY IN THE WORLD

ERIE CITY steam

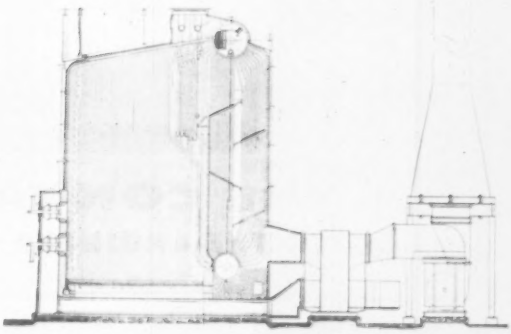
powers processing at FORTIER PLANT

This $50,000,000 plant processes natural gas, air, water and sulphur to produce a variety of petrochemical products, most important of which is acrylonitrile, basic to farm and industry.

Dependability is of prime importance in petrochemical processing. That is why we are proud that Erie City steam generators were selected for Fortier Plant. Cyanamid gets its natural gas from the abundant Louisiana fields, its water from "ole man river", and its steam from 3 Erie City 200,000 lbs./hr. boilers.

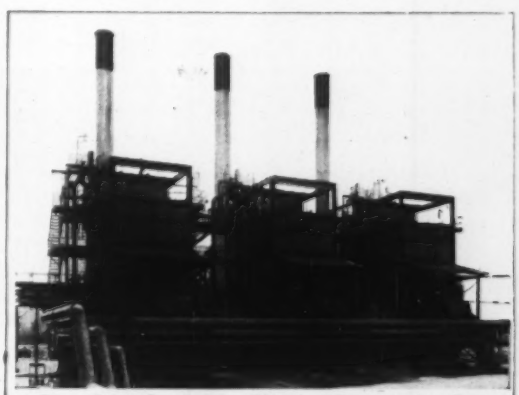
With over 40 years experience as a pioneer manufacturer of 2-drum boilers and with experience gained in hundreds of installations, Erie City adapts its original basic design to any special application. This outdoor application is compact with completely water cooled furnaces integral with main circulation system. Heavy refractory linings are eliminated and continuously high ratings can be carried. These boilers feature wide flexibility, quick response to load changes and produce high quality steam.

Erie City designs and builds all major components of its broad line and offers undivided responsibility. For the facts on the complete line ask for Bulletin SB-504-M.



Boiler Data

3 BOILERS	Erie City 2-drum
Capacity	200,000 lbs./hr.
Design Pressure	700 p.s.i.g.
Total Steam Temperature	750°F.
3 SUPERHEATERS	E. C. Pendant type



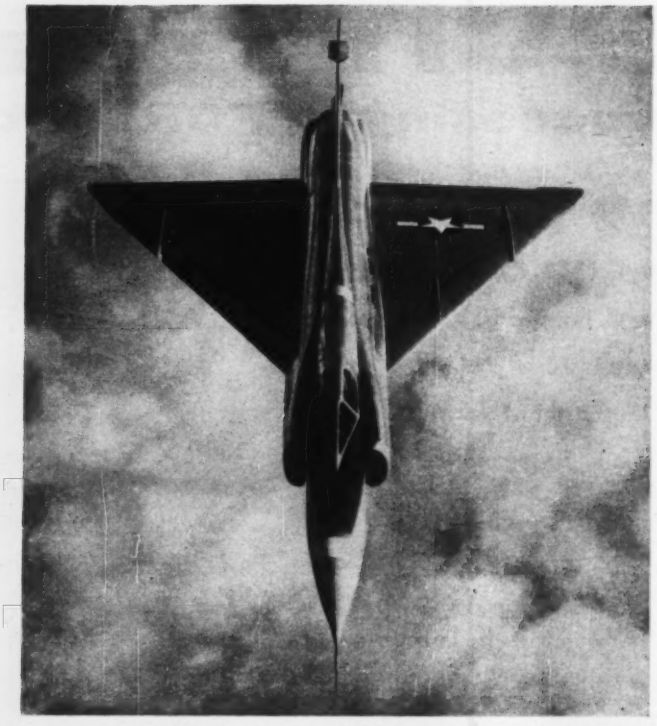
Consulting Engineers: Chemical Construction Corp. of American Cyanamid Company

ERIE CITY
116 Years in Steam Generation

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS



THE CONVAIR CHALLENGE

TO THE ENGINEER OF EXCEPTIONAL ABILITY

Beyond the obvious fact that Convair in San Diego offers you a way of living judged by most as the nation's finest from the standpoint of weather, beauty and interesting surroundings, the Convair Engineering Department offers you challenges found in few places.

It is, we believe, an "engineer's" engineering department – interesting, energetic, explorative – with the diversity that means security for capable personnel.

As proof, consider this: Convair developed and flew the world's first turbo-prop airplane, first delta-wing airplane, first vertical take-off airplane, first delta-wing seaplane – engineered and built the world's biggest transport, the world's safest high-performance commercial aircraft.

Or this: Convair's B-36 is the world's largest operational bomber, Convair's B-24 Liberator was World War II's most used heavy bomber, Convair's XP5Y-1 holds the world's endurance record for turbo-prop aircraft.

Or this: Convair was awarded the nation's first production missile contract and the first production contract for supersonic interceptors.

Currently . . . Convair has the greatest diversity of aircraft engineering projects in the country, including the F-102A supersonic interceptor, the new Metropolitan 440 airliner, the Convair 880 jet liner, the Atlas intercontinental ballistic missile, plus a long-range study of nuclear aircraft.

Currently . . . Convair has a completely integrated electronic development section engaged in advanced development and design on missile guidance, avionic projects and radar systems.

Would you like to join us? We earnestly need engineers of proven ability – men who want to make full use of their time, their minds, their skills and abilities solving the complex problems confronting us in these projects. If you are such a man, write us and we'll send you a free booklet about us, plus other interesting material to help you make the decision.

Write: H. T. BROOKS, Engineering Personnel

Department 622

C-V CONVAIR GD

A DIVISION OF GENERAL DYNAMICS CORPORATION

3302 PACIFIC HIGHWAY

IN BEAUTIFUL SAN DIEGO, CALIFORNIA

REDUCE ENGINEERING COSTS WITH THE NEW GF Draft-a-Matic®

Greater employee comfort

increases efficiency... reduces lost board time

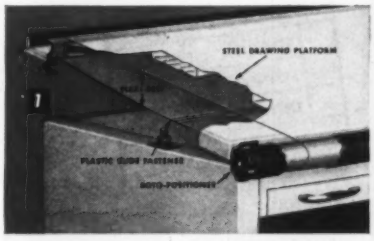
Now... Draft-a-Matic's exclusive Roto-Positioner delivers the drawing to the man, making possible the use of a comfortable office chair, individually adjusted to the draftsman's needs.

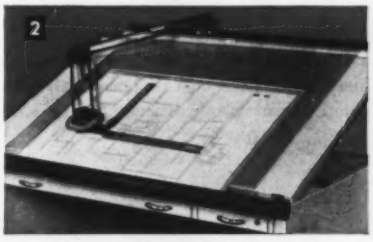
Fatigue caused by standing, stooping, stretching, perching on the edge of the stool is automatically eliminated when you install Draft-a-Matic. No more costly time-outs to relieve ill effects of poor working posture. Efficiency steps up . . . personnel turnover goes down. In this and many other ways, Draft-a-Matic helps reduce over-all engineering costs.

For the full story, see Draft-a-Matic now at your local GF showroom . . . you'll find it listed in the Yellow Pages. Or write for free 8-page Draft-a-Matic booklet. The General Fireproofing Co., Department Q-59, Youngstown 1, Ohio.

THESE FEATURES MAKE **DRAFT-A-MATIC** WORLD'S FINEST

- All metal construction with baked-on finish. No warping.
- Velvoleum covered drafting platform adjustable 0 to 85°.
- Height of entire unit adjustable from 30" to 39" at 1" intervals.
- Large center drawer. Locking instrument tray.
- Shelf and storage drawer arrangements to suit individual needs.
- Large sliding reference shelf for extra convenience.
- Designed for space-saving row installation.
- Accommodates parallel straight edge, drafting machine, lamp.
- Exclusive Flexi-Belt and Roto-Positioner delivers the work to the man.





1. Drawing is affixed to endless vinyl plastic belt. By merely turning Roto-Positioner wheel, draftsman moves drawing into working range while remaining comfortably seated.

2. Draft-a-Matic will accommodate drafting machine, parallel straight edge, lamps and similar accessories. Drawing platform is covered with Mist Green Velveleum.

3. Row arrangement creates a complete work station in only 32 square feet. Immediately behind draftsmen are drawers and shelves for reference material and a handy sliding work shelf.

MODE-MAKER DESKS • GOODFORM ALUMINUM CHAIRS
SUPER-FILER MECHANIZED FILING EQUIPMENT • GF ADJUSTABLE STEEL SHELVING

GF metal business furniture is a **GOOD** investment

GF®
GENERAL FIREPROOFING
Foremost in Metal Business Furniture

Bailey Recorder for receiving pneumatic and electric signals.

Measured Variables
% combustibles
combustion
conductivity
density
differential
draft
flow
liquid level
% oxygen
pH
position
pressure
ratio
smoke density
specific gravity
speed
temperature
vacuum

Pick any four, plug in, and record

Here is a receiver recorder, custom-built *by you* to meet your needs, no matter how changeable, how complex. On a single chart you can record any four measured variables—and interchangeable receivers permit new combinations almost at will.

Individual plug-in pneumatic or electronic receivers—and corresponding integrators—are interchangeable in the four identical frame slots. You can select any combination; even including two receivers and their two integrators.

Think what this can mean to you! Parts inventories are minimized; re-use of components keeps instrumentation costs economically low when cycle changes are frequent—and you can even tie in with your existing transmitters.

Ask for Product Specification E12-5.

ONLY BAILEY OFFERS ALL THESE ADVANTAGES IN A SINGLE RECORDER

- Pre-calibrated plug-in receiver units
- Up to four pneumatic or electronic receivers —or two receivers and two integrators
- Any four variables on one chart—easily read and interpreted
- A full year's ink supply at one loading
- Faster ordering—from stock
- Minimum inventory of parts
- Minimum instrument investment for process cycle expansion or alteration

BAILEY METER COMPANY

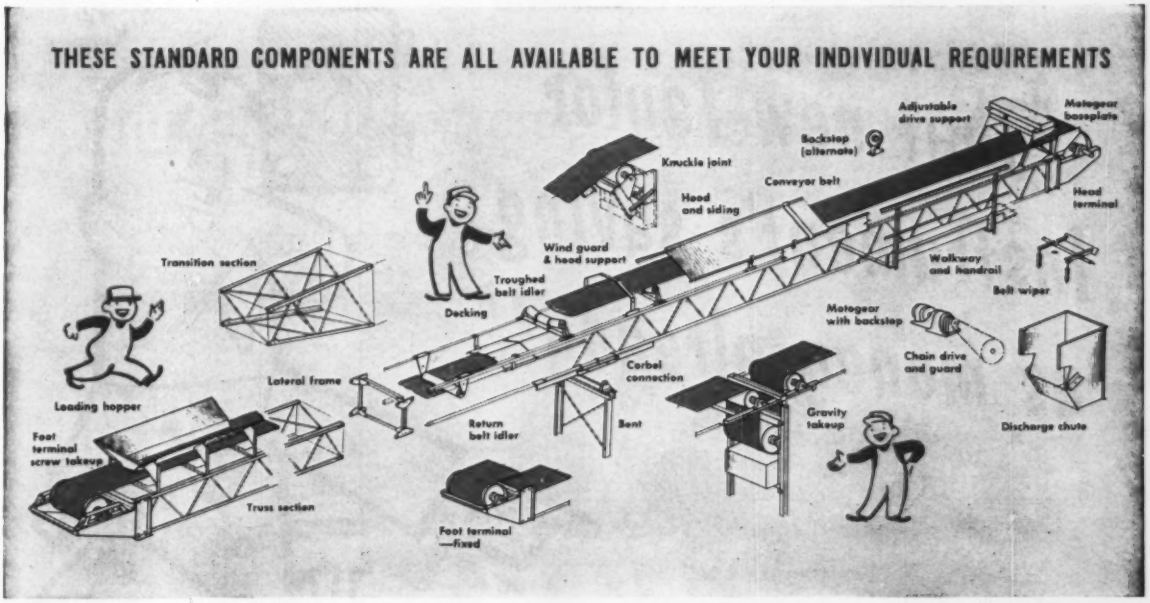
1026 IVANHOE ROAD

CLEVELAND 10, OHIO

Controls for Power and Process

BAILEY METER

Controls for
TEMPERATURE
PRESSURE
GAS ANALYSIS
FLOW LEVEL
RATIO DENSITY



NOW! The advantages of engineered belt conveyors in a LINK-BELT

PRE-BILT PACKAGE

easy selection

Your Link-Belt representative will help you select the best combination of PRE-BILT sectional belt conveyor components.

Standard 18, 24, 30 and 36-inch widths need no special engineering

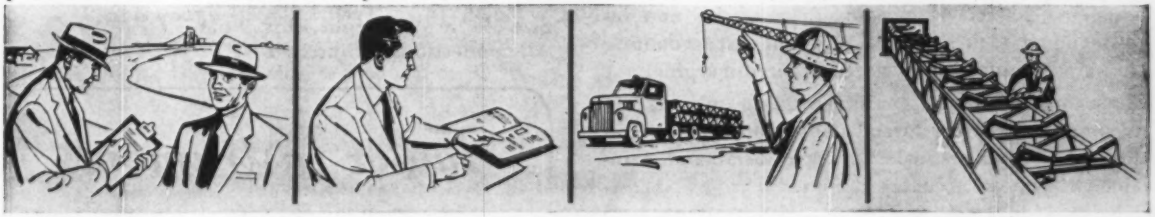
Here's an economical, standardized belt conveyor "package" . . . ready to meet the majority of belt conveyor needs and perform dependably for years and years. It combines standard Link-Belt products with sectional truss frames and steel supporting bents.

Book 2579 has further data on Link-Belt PRE-BILT conveyors . . . with drives up to 40 hp and 24 and 42-inch truss depths. Write today, or ask for a copy at your nearest Link-Belt office.

LINK-BELT

14.114

BELT CONVEYOR EQUIPMENT



prompt quotations

He will prepare a comprehensive and accurate estimate of requirements for installations that permit "on-the-ground" survey.

simplified purchase

Parts are standardized, interchangeable, all available from one supplier. Link-Belt representative can furnish all data.

quick delivery

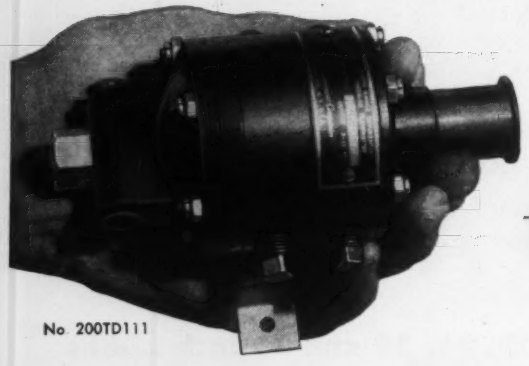
PRE-BILT conveyors are built at nine strategic locations throughout the country and are shipped from the plant nearest you.

fast installation

Can be readily handled by your own erectors in most cases. Link-Belt can also furnish complete erection service and supervision.

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

"That new Taylor Instrument's saving us money already!"



No 200TD111

He's talking about the new Taylor low-cost Flow Transmitter!

THE reason he can spot the savings so quickly is that the No. 200TD111 Fixed Range Differential Pressure Transmitter is being used to measure departmental consumption of steam, air and water that previously went unchecked. That 3-pen recorder in the background shows at a glance how much is being used by a given department as a basis for apportioning costs. It's the remarkably low price of this new instrument that makes it such a practical cost accounting aid on applications hitherto considered marginal.

Measuring only 6½" x 3" and weighing only 4½ lbs., its simplified piping, force-balance construction and external adjustments make it easy to install and maintain. Calibration accuracy is better than 1%. Sensitivity exceeds 0.1%. Ranges 0 to 50, 100, 200 and 300 inches of water. Built for rough service and outdoor mounting.

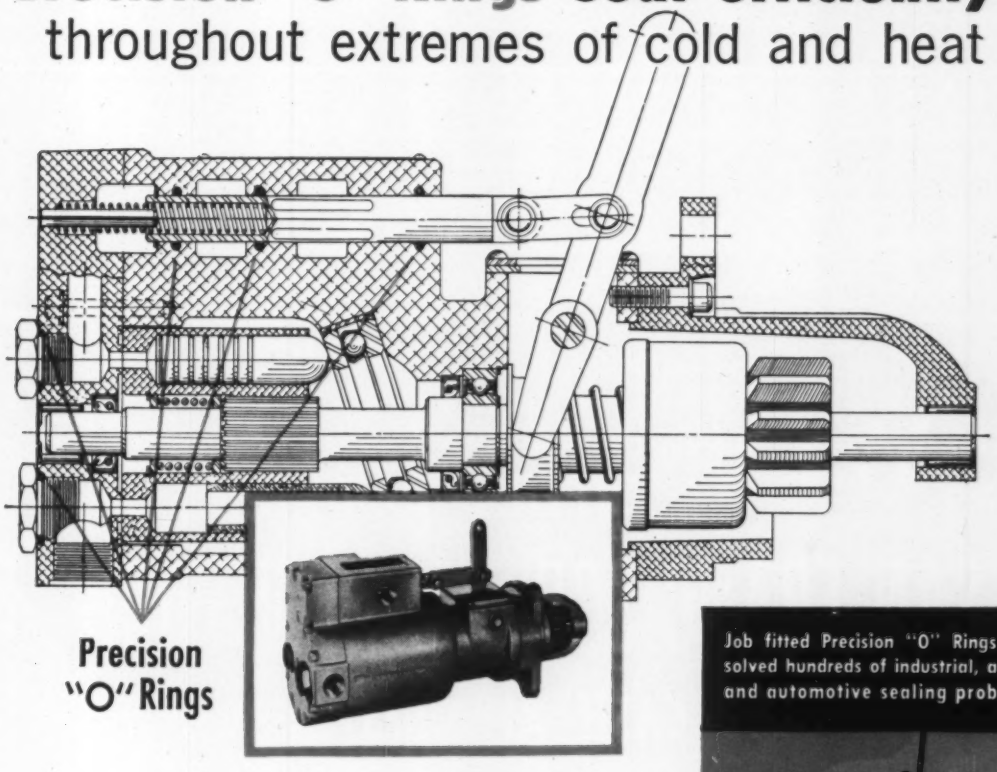
Call your Taylor Field Engineer, or write for **Bulletin 98274.** Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

DESIGN SPECIFICATIONS

Diaphragm of Neoprene-impregnated Nylon.
Body material, brass.
Maximum working pressure: 150 psi.; temperature 150°F.
Air Supply pressure, 20 psi.
Air consumption, 0.10 standard cu. ft. per minute.
Output pressure range 3 to 15 psi.
Size 6½" x 3". Weight 4 lbs. 9 ozs.
All connections ¼" internal NPT.

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

Precision "O" Rings seal efficiently throughout extremes of cold and heat



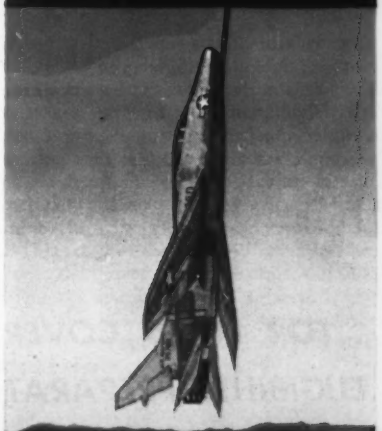
The Hydrotor Hydraulic Cranking Motor, manufactured by Hydramotive, Inc., Cleveland, Ohio, provides high cranking torque and adjustable speeds over a temperature range of −65° to +165° F.

Hydramotive, Inc., standardized on Precision "O" Rings after exhaustive competitive tests. Precision "O" Rings guaranteed long life sealing and flexibility in arctic cold.

Precision "O" Rings are compression molded from quality controlled compounds. They're the finest made! Rigid inspection and engineering skill assure long life, leak proof sealing. Precision can furnish the size and compound that fits your requirements and "O" rings that meet all military and commercial specifications.

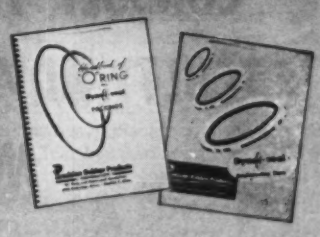
What is your sealing problem? There is an expert—the Precision engineer—ready to help you in product design. Rely on Precision, the world's largest exclusive producer of "O" rings.

Job fitted Precision "O" Rings have solved hundreds of industrial, aircraft and automotive sealing problems.



Precision "O" Rings meet military specifications and were used in the North American F-100C Super Sabre.

Write for your free copies of Precision catalogs on "O" Rings and Dyna-seals



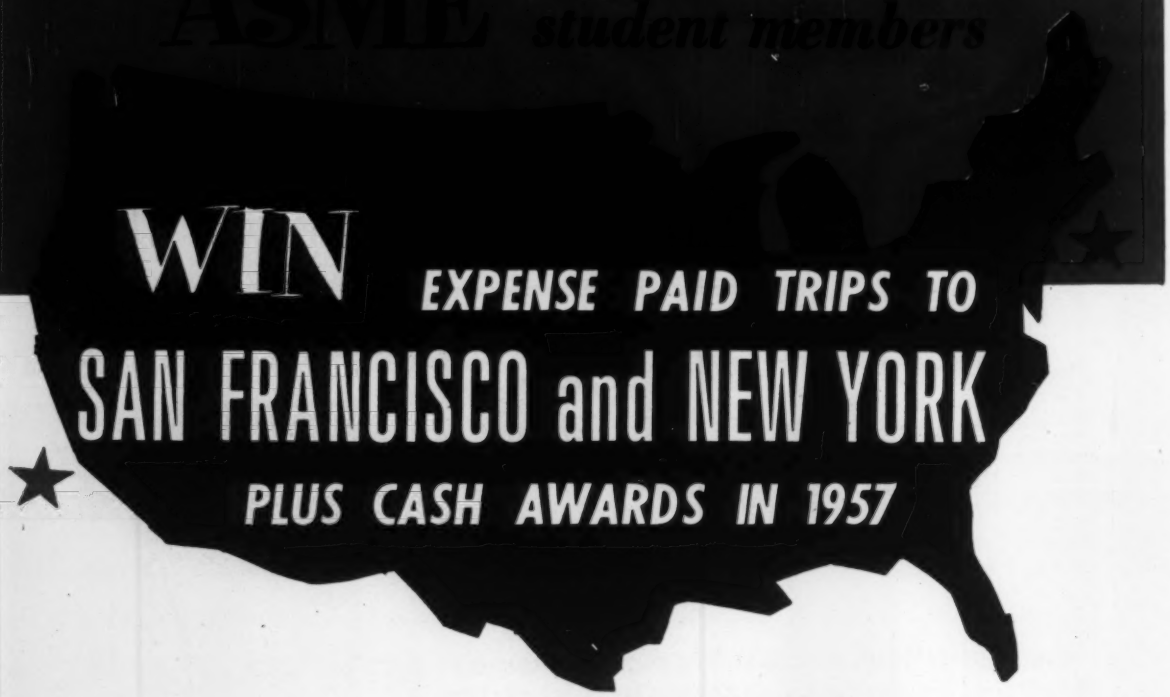
Precision Rubber Products Corporation • "O" Ring and Dyna-seal Specialists

Dept. 9, Oakridge Drive, Dayton 7, Ohio

Canadian Plant at: Ste. Thérèse de Blainville, Québec

attention...

ASME student members



WIN EXPENSE PAID TRIPS TO SAN FRANCISCO and NEW YORK

PLUS CASH AWARDS IN 1957

FOR RULES COVERING ELIGIBILITY, PREPARATION AND CLOSING DATES FOR THESE AWARDS

CONSULT YOUR FACULTY ADVISER NOW!

1 CHARLES T. MAIN AWARD
$150 cash prize and trip to New York for the best paper on the subject of, "A Critical Analysis of Student Sections of the National Engineering Societies."

2 OLD GUARD PRIZE
$150 cash award and trips to San Francisco and New York.

3 UNDERGRADUATE STUDENT AWARD
$25 cash prize plus trip to New York for best paper on an engineering subject.

4 POSTGRADUATE STUDENT AWARD
$25 cash prize plus trip to New York for best paper on an engineering subject.

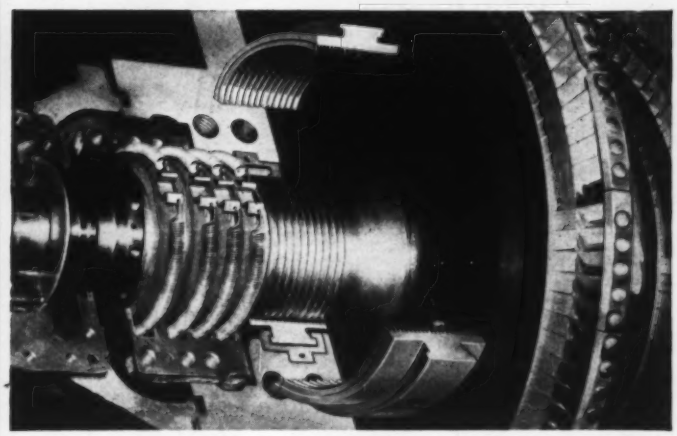
On all General Electric High-speed Turbines,

Well-designed, efficient seals...

Highly efficient, easily-replaced carbon packings

For the most effective shaft-end sealing, well-designed, low-cost carbon packings are used on G-E High-speed Turbines to seal steam pressures up to 75 psig. Made of non-galling, self-lubricating carbon-graphite, these segmental rings have high mechanical strength in the small sizes used, assuring long life under normal operating conditions. A garter spring in an offset "V" groove holds each ring together and presses it firmly against the side of the chamber, forming a tight seal. This unique arrangement permits the rings to support their own weight and to adjust themselves to the shaft position, thereby reducing wear and increasing the life of the seal. The rings are contained in compact external packing boxes, and can be easily inspected or replaced without breaking the horizontal joint of the wheel casing.

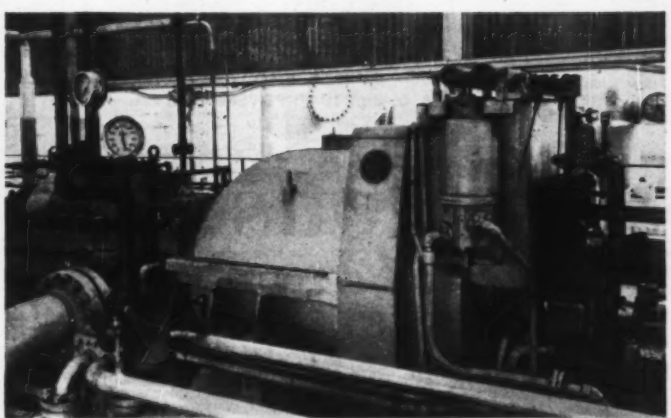
cut steam leakage...



Reliable, long-life metallic-labyrinth seals

To effectively minimize shaft-end steam leakage where shell pressures exceed 75 psig, segmental, high-low tooth metallic-labyrinth seals are used in combination with carbon packing. Between stages, straight-tooth metallic-labyrinth seals are always used. For maximum seal efficiency, minimum clearances between the teeth and the shaft are maintained by precision-machined hook fits in the packing housing. Shaft scoring is practically eliminated since the leaded-bronze segments are spring-backed and can move outward should there be accidental contact with the shaft. When unbalanced steam pressure forces axial movement of the seals, the shoulders of the rings and the housing engage to form a tight steam seal. All labyrinth seals are designed to compensate for thermal expansion, thus assuring a most efficient steam seal at operating temperatures.

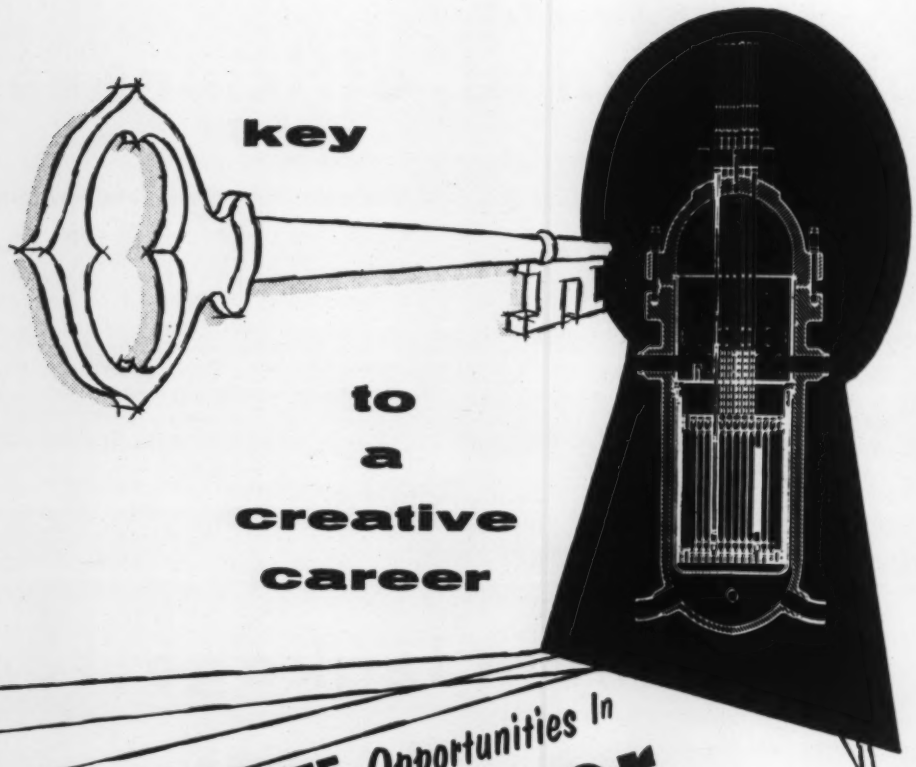
reduce maintenance costs



The careful design and manufacture of these steam seals is your further assurance of low maintenance and consistent reliability of G-E High-speed Turbines. Why not check into the many other sound design features built into these mechanical drives? Your Apparatus Sales Representative will be glad to explain the many benefits they offer to your operation. Contact him for further information or write for Bulletin GEA-6232, General Electric Company, Section 241-7, Schenectady, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC



New IMMEDIATE Opportunities In atomic power

No Delays Awaiting Security Clearance

Take this unique opportunity to become associated with an exciting new organization. Your career begins immediately. Participate in provocative assignments that go far beyond simply whetting your creative appetite . . . assignments that hold the promise of limitless professional growth.

ELECTRICAL ENGINEERS
Graduate, for development of control systems for Atomic Power Reactors. General control experience in power station, aircraft, marine vessels or automatic machinery desirable.

QUALITY ENGINEERS
Graduate, for standard development in radiography, ultra-sonic & other non-destructive testing techniques. SR. QUALITY CONTROL engineers, ME or extensive background high precision machinery. Experienced stainless steels, heavy mfg. desirable.

MECHANICAL ENGINEERS
Graduate, for component specifications, design, manufacturing & installation of pressure vessels, valves, pumps, heat exchangers & hi-pressure piping. Special need for welding engineers & materials & process engineers.

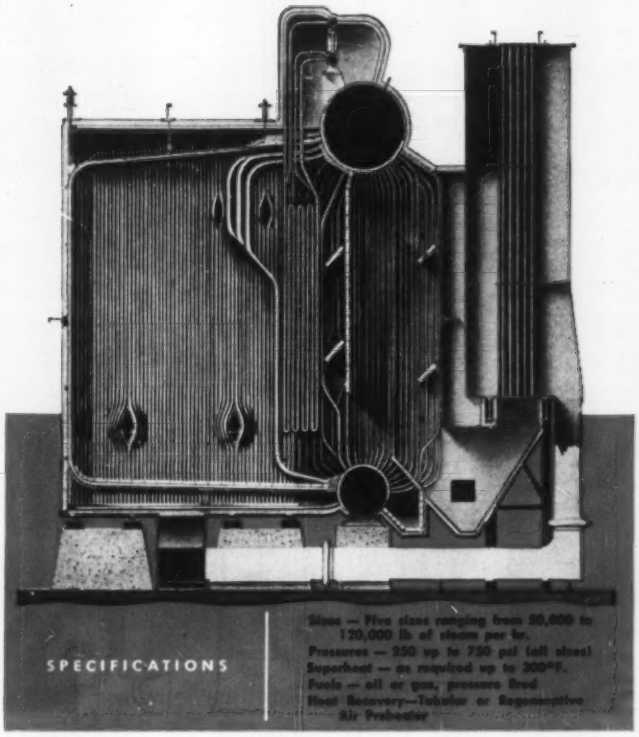
MANUFACTURING ENGINEERS
ME, Metallurgical degree or equivalent. Experience or familiarity machining & fabrication stainless pressure vessels & heat exchangers, hi-pressure piping systems; welding to ASME & Navy requirements. Some travel involved.

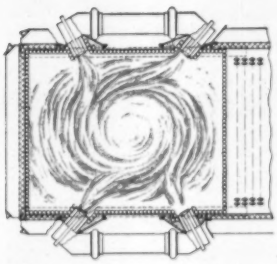
FOR CAREER INTERVIEWS
Send Resume to
MR. JOHN D. BATEY, Dept. M-2
P. O. Box 1047, PITTSBURGH, PA.

WESTINGHOUSE

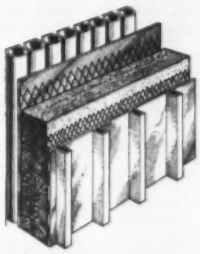
Westinghouse
First In Atomic Power

THE VU-55 ... AN OUTSTANDING BOILER BUY FOR CAPACITIES FROM 50,000 TO 120,000 LB OF STEAM PER HOUR!


SPECIFICATIONS
Sizes — Five sizes ranging from 50,000 to 120,000 lb of steam per hr.
Pressures — 250 up to 750 psi (all sizes)
Superheat — as required up to 200°F.
Fuels — oil or gas, pressure fired
Heat Recovery—Tubular or Regenerative Air Preheater



PLAN VIEW OF FURNACE showing arrangement of burners for tangential firing. Flame streams from the four burners impinge upon one another at high velocity, creating a turbulence unattainable by any other method of firing. The result is rapid and complete combustion. As the gases spiral upward, they sweep all furnace heating surfaces, assuring a high rate of heat absorption.



PERSPECTIVE OF FURNACE WALL. Construction consists of tangent tubes backed up successively by welded steel panels, 4 inches of high quality insulating material and an outer steel casing formed as shown to provide adequately for expansion and assure ample strength. Low heat loss and the tightness required for pressure firing are assured by this double-wall construction.

The VU-55 – a development of Combustion's basic Vertical Unit design – offers features never before available in a boiler of its capacity range. If your steam needs call for a unit in the 50,000 to 120,000-lb class, you will find it worth while to consider the economic and operating advantages assured by these VU-55 features:

TANGENTIAL FIRING. More than 20 years of application experience have established the exceptional advantages of tangential firing, illustrated and briefly described below. About 90 percent of Combustion's large utility installations use this advanced method of firing.

DOUBLE WALL, PRESSURIZED CASING. The latest development in casing construction for pressure firing of boilers in the size class of the VU-55, this casing, as illustrated and described below, is designed to assure lifetime tightness with minimum heat loss. Pressure firing permits the elimination of an induced draft fan with its attendant operating and maintenance costs.

TANGENT FURNACE TUBES. The VU-55's furnace tube arrangement provides complete heat-absorbing, water-cooled protection on all furnace walls. Furnace maintenance is minimized, refractory expense is eliminated, heat absorption rates per sq ft are higher.

SIMPLIFIED ERECTION. Shop assembly of furnace wall panels and boiler screen tubes saves time and money in handling, transportation and erection.

HIGH STEAM QUALITY. Equipped with a large (60-in.) steam drum, the VU-55 has generous water capacity and steam reservoir space. C-E drum internals assure high quality steam at all ratings.

STREAMLINED EXTERIOR. The overall appearance of the VU-55 reflects the efforts of its designers to achieve a completely unobstructed casing, while retaining adequate access wherever required and every facility for convenient operation. There are no outside downcomer tubes, and ducts from air heater to burners are beneath the furnace floor.

Your request for further information on the VU-55 Boiler will receive prompt attention

COMBUSTION ENGINEERING

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.
CANADA: COMBUSTION ENGINEERING-SUPERHEATER LTD.

C-E B-938A

STEAM GENERATING UNITS · NUCLEAR REACTORS · PAPER MILL EQUIPMENT · PULVERIZERS · FLASH DRYING SYSTEMS · PRESSURE VESSELS · HOME HEATING AND COOLING UNITS · DOMESTIC WATER HEATERS · SOIL PIPE

Curtiss-Wright **PROTOTYPE SERVICE** speeds you from blueprint to working model

Here's the fast, efficient and economical way to get working models from your turbine or compressor blade designs . . . whether you want a single prototype or test production quantities. Curtiss-Wright's Metals Processing Division scales down its complete facilities in a modern, geared-to-speed prototype shop . . . brings under one roof all the production steps from primary metal to finished product in any high integrity alloy.

Working model production brought to a fine point of precision control means more accurate development now . . . smoother flowing production later. Coordinated facilities for casting, forging, grade rolling, machining and extrusion are ready to serve you on short notice . . . solve your problems in a hurry. Contact Curtiss-Wright when your next set of designs leaves the drafting board. Qualified engineering consultation available at all branch offices.

For complete details, write to: **84 Grider Street**

METALS PROCESSING DIVISION
CURTISS-WRIGHT
CORPORATION • BUFFALO, NEW YORK

METALS PROCESSING DIVISION BRANCH OFFICES: • • • NEW YORK • HOUSTON • LOS ANGELES

ELECTRONICS • NUCLEONICS • PLASTICS • METALLURGY • ULTRASONICS • AVIATION

RESERVE YOUR

FREE

COPY NOW!

GET THIS

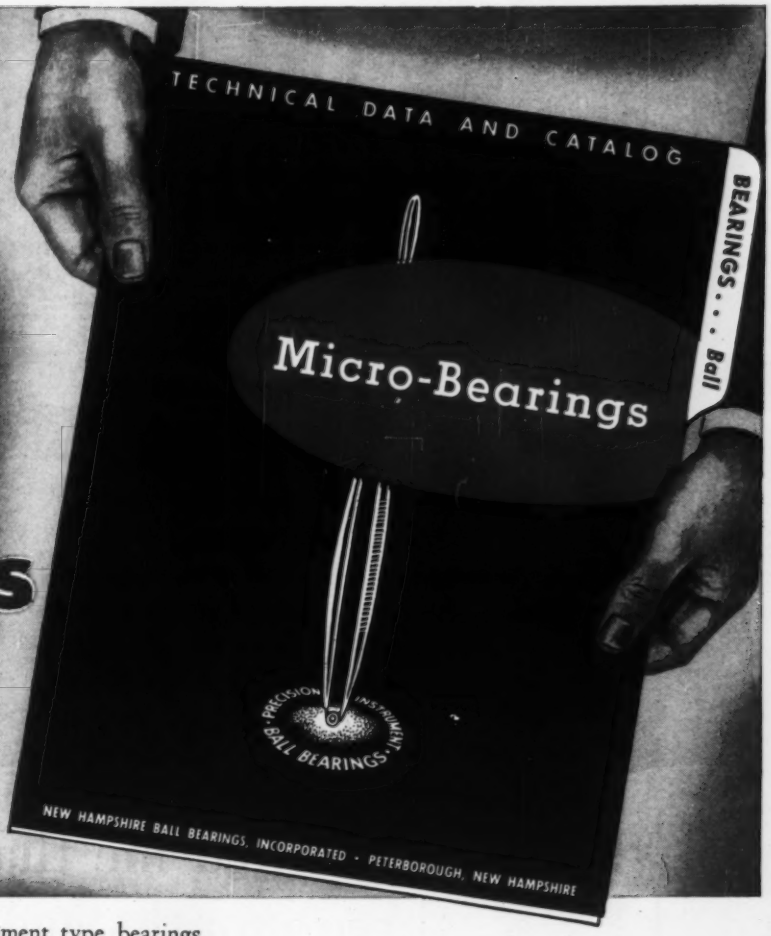
NEW

Technical Reference Manual and Catalog on

MICRO BEARINGS

SMALL INSTRUMENT BALL BEARINGS

This brand new concept in bearing catalogs will help solve your design problems!


TECHNICAL DATA AND CATALOG
Micro-Bearings
BEARINGS . . . Ball
PRECISION INSTRUMENT BALL BEARINGS
NEW HAMPSHIRE BALL BEARINGS, INCORPORATED • PETERBOROUGH, NEW HAMPSHIRE

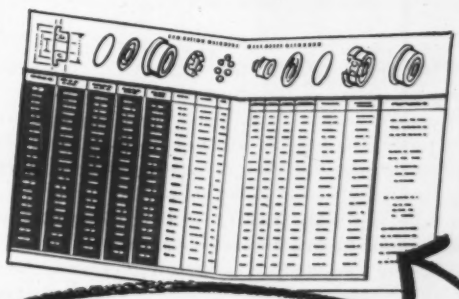
If you work with small instrument type bearings you'll find this new, authoritative publication an extremely valuable and handy source of engineering data arranged in convenient form for practical reference.

LOOK AT THESE FEATURES . . .

- A helpful survey article: "FACTORS TO CONSIDER IN SELECTING SMALL INSTRUMENT BALL BEARINGS."
- A complete, practical presentation of bearing facts:

Types of bearings
Materials
Components
Engineering standards
Tolerances
Dynamic and static loads
Lubrication
Radial and Axial play
Torque
Mounting practice etc.

- Large, clear illustrations.
- Big, easy to follow charts.
- Convenient nomographs and conversion charts.
- Simple bearing designations make ordering easy.



WRITE TODAY . . . GET YOUR NAME ON OUR PRIME DISTRIBUTION LIST FOR MAILING

NEW HAMPSHIRE BALL BEARINGS, INC., *Peterborough, New Hampshire*

"If you had asked me that question three months ago..."

"—I would have been ashamed to answer you. But today, I'm glad to say, we have a good Payroll Savings Plan—with 84.4% of our employees enrolled.

"Of course, we've always had The Plan—put it in during the war—but with changes in personnel and our failure to present the Plan to new employees, participation dropped to almost nothing.

"One day our State Director of the Savings Bond Division, U. S. Treasury Department, dropped in to see me. When he told me how far below average we were I asked him what we could do to bring it up. He gave me a complete campaign built around a person-to-person canvass that would put a Payroll Savings Application Blank in the hands of every employee, with the Treasury furnishing pay-envelope stuffers, posters and other literature. I was a little dubious about the personal canvass but our employees were enthusiastic, in fact, officials of our union volunteered to undertake the canvass. There was no pressure, no teams, no prizes—just the distribution of the Application Blanks. Our employees did the rest—84.5% enrollment.

"84.5% is a good enrollment but we are not going to rest on it. A number of companies are in the 90% bracket—that's our goal."

Your State Director, Savings Bond Division, U. S. Treasury Department, will be glad to help you install The Payroll Savings Plan, or build participation in an existing plan. Write: Savings Bond Division, U.S. Treasury Department, Washington 25, D. C.

The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

MECHANICAL ENGINEERING

Laboratory precision at mass production costs!

LINEAR ROTO-MOLD "O" RINGS

Do you have the facts on Linear's new, exclusive ROTO-MOLD process? It brings *automation* to the packing industry—makes possible fast delivery of perfectly uniform "O" Rings in any quantity!

★ Linear ROTO-MOLD "O" Rings are made with laboratory precision in single cavity molds under individually controlled pressure. Molding dies are automatically brought into microscopic alignment.

★ Every ROTO-MOLD "O" Ring is perfectly circular in cross section, with no transverse or other seams. You get precise uniformity without trimming or grinding.

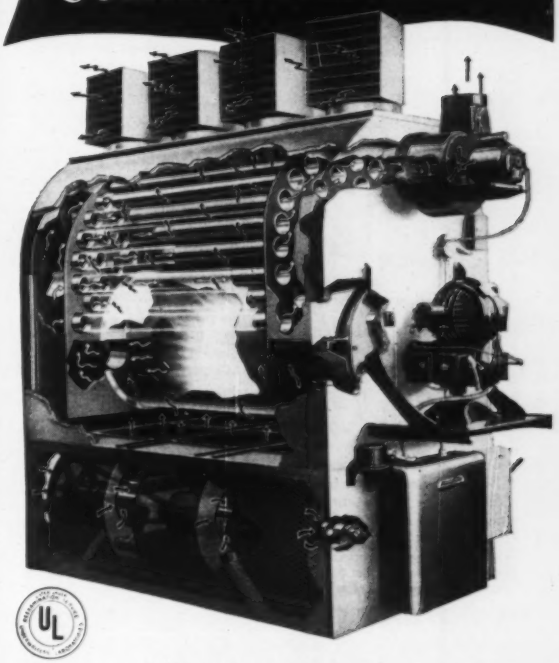
Linear ROTO-MOLD "O" Rings are available now, in a variety of sizes and compounds, to meet your exacting requirements. Write, phone or wire for complete details.

"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILADELPHIA 35, PA.

Commercial-Aire

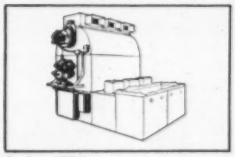


DIRECT-FIRED

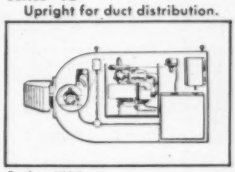
Space Heaters

300,000 BTU's TO 2,000,000 BTU's

Provides industry with lowest cost heating. Primary cylindrical stainless steel combustion chamber, secondary heat-extracting tubes, consistent rate of combustion gas flow provide high efficiency, utilizing 80% of available heat of fuel. Highly adaptable to desired mounting arrangements. Features low first cost, easy maintenance, complete accessibility to all service points. Completely equipped and wired with controls for economical installation.

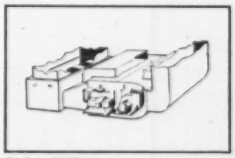


Series "FD"
Upright for duct distribution.



Series "H"
Horizontally suspended.

Series "U"
Inverted suspended.



Series "HD"
Horizontally for duct distribution.

MAMMOTH FURNACE CO.
6421 Cambridge St.
Minneapolis, 16, Minn.

Send full details, prices, delivery dates, etc., on Commercial-Aire Heaters.

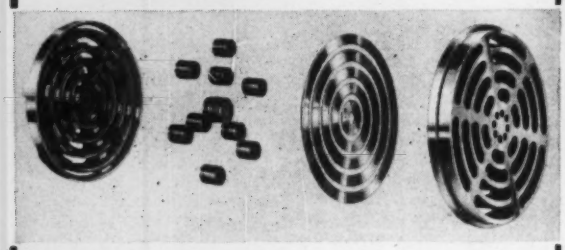
NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

install J.H.H. VOSS VALVES in your compressors for peak performance

(AIR • GAS • AMMONIA)



Peak performance, maximum efficiency, greater output, and lower power costs can be built into your oldest, and of course your newest, compressors by the installation of VOSS VALVES.

Check THESE VOSS VALVE ADVANTAGES:

- Quiet, vibration-free operation
- 20 to 60% more valve area
- less power consumption
- minimum pressure loss
- normal discharge temperature
- lower operating costs
- utmost safety

Our detailed proposal for improving efficiency of your compressor will be sent without obligation. Send name, bore, stroke, and speed of your machine.

J.H.H. VOSS VALVES REG. U.S. PAT. OFF.

J. H. H. VOSS CO., INC.
785 East 144th St., N. Y. 54, N. Y.

"MONOBALL"®
Self-Aligning Bearings

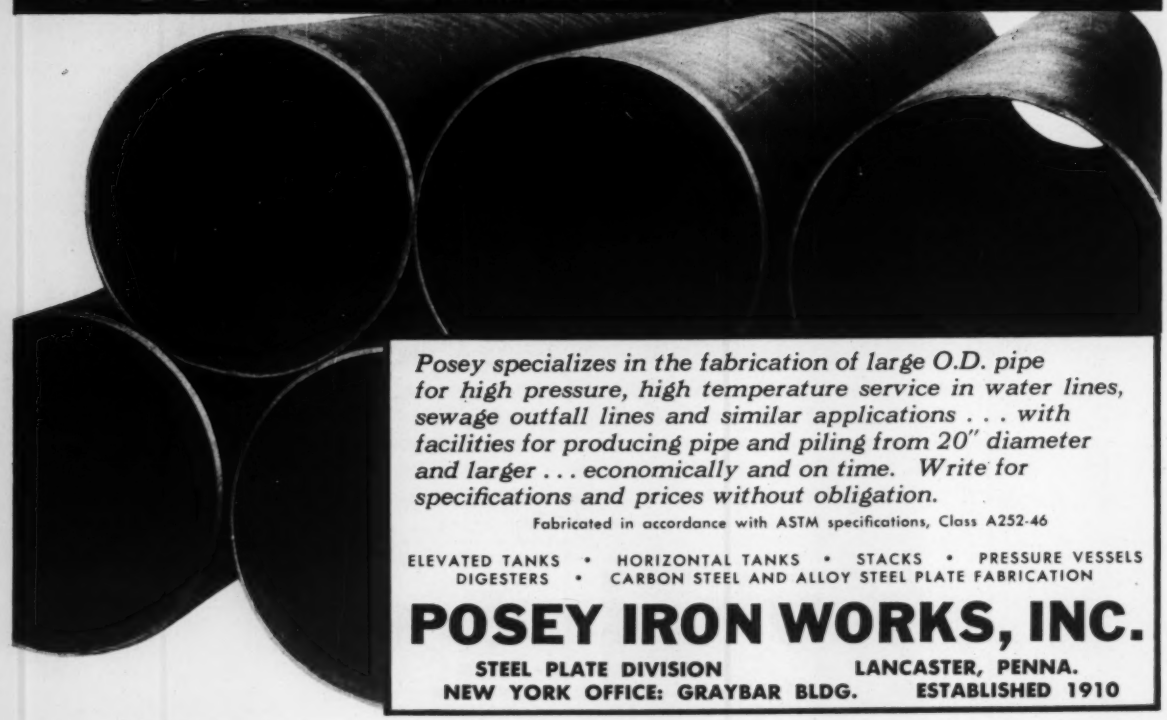
CHARACTERISTICS

	ANALYSIS	RECOMMENDED USE
1	Stainless Steel Ball and Race	For types operating under high temperature (800-1200 degrees F.).
2	Chrome Moly Steel Ball and Race	For types operating under high radial ultimate loads (3000-893,000 lbs.).
3	Bronze Race and Chrome Moly Steel Ball	For types operating under normal loads with minimum friction requirements.

Thousands in use. Backed by years of service life. Wide variety of Plain Types in bore sizes 3/16" to 6" Dia. Rod end types in similar size range with externally or internally threaded shanks. Our Engineers welcome an opportunity of studying individual requirements and prescribing a type or types which will serve under your demanding conditions. Southwest can design special types to fit individual specifications. As a result of thorough study of different operating conditions, various steel alloys have been used to meet specific needs. Write for revised Engineering Manual describing complete line. Dept. ME-56

SOUTHWEST PRODUCTS CO.
1705 So. Mountain Ave. • Duarte, California
(LOS ANGELES COUNTY)

POSEY LARGE O. D. PIPE



Posey specializes in the fabrication of large O.D. pipe for high pressure, high temperature service in water lines, sewage outfall lines and similar applications . . . with facilities for producing pipe and piling from 20" diameter and larger . . . economically and on time. Write for specifications and prices without obligation.

Fabricated in accordance with ASTM specifications, Class A252-46

ELEVATED TANKS • HORIZONTAL TANKS • STACKS • PRESSURE VESSELS
DIGESTERS • CARBON STEEL AND ALLOY STEEL PLATE FABRICATION

POSEY IRON WORKS, INC.

STEEL PLATE DIVISION LANCASTER, PENNA.
NEW YORK OFFICE: GRAYBAR BLDG. ESTABLISHED 1910

Always Available – Quickly!

RHOPAC Top Quality

Gaskets and Tapes. Making gaskets and tapes from top quality Asbestos Wire Inserted Cloth is a Rhopac specialty. Specify Rhopac boiler gaskets, folded tapes (plain or tadpole), and retort door packing. Prompt service — low prices.

Sheet Gasket Materials. All standard gasket materials in various thicknesses kept in stock at all times — available in sheet or roll form. Your order will receive immediate attention.

Rhopac Packing Hooks. A packing extractor whose flexible shaft greatly simplifies the removing of old, worn-out packing. In set of 3 handy sizes — other sizes available. A great time and labor saver.

Mechanical Packings. We stock a wide selection of high temperature, high pressure and all standard types of packing. Special requirements are also developed and produced on short notice.

See Rhopac on All Gasket and Packing Problems

Exceptional Service — Top Quality

Rhopac, Inc.

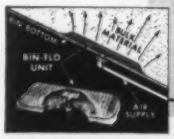
3407 Cleveland Avenue, Skokie, Illinois

Manufacturers of mechanical packings, industrial and boiler gaskets, steel rule dies, flexible packing hooks.

BULK MATERIAL CONTROL under Pressure or Vacuum

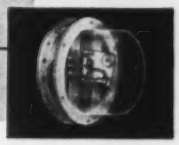
New Roto-Bin-Dicator mounts outside bin, at any angle, for bin level signaling or machinery control. Material loads on paddle actuate Micro switch in motor housing. Flexible paddle shaft permits use with large or lumpy materials. **Explosion-Proof U. L. Listed Units Now Available.**

ROTO-BIN-DICATOR



BIN-DICATOR

BIN-FLO AERATOR



Low pressure air diffuser assures steady flow of fine, dry materials that tend to pack in storage.

The original diaphragm-type bin level indicator for all ordinary applications.

Complete Illustrated Literature FREE

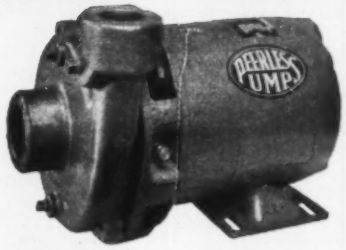
THE BIN-DICATOR CO.

13946-W Kercheval • Detroit 15, Mich.

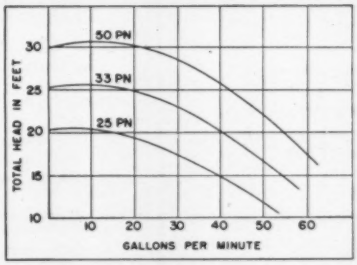
Phone: VAlley 2-6952

WE SELL DIRECT • PHONE ORDERS COLLECT

IF YOUR EQUIPMENT CALLS FOR A PUMP WITH:



TYPE PN 1/4, 1/3, 1/2 hp; low head (up to 30 ft.); capacities up to 60 gpm.



PEERLESS PUMPS

One or a truckload from two big factories at Indianapolis, Indiana or Los Angeles, Calif:

This DESIGN **These CHARACTERISTICS** **This AVAILABILITY**

...then you want a

PEERLESS TYPE PN *Fluidyne*® PUMP

A LOW HEAD PUMP WITH HIGH EFFICIENCY

A HIGH QUALITY PUMP WITH A LOW PRICE TAG

PEERLESS PUMP DIVISION

FOOD MACHINERY AND CHEMICAL CORPORATION

Factories: Indianapolis 8, Ind. and Los Angeles 31, Calif., *Offices:* New York; Indianapolis, Chicago, St. Louis, Atlanta, Lubbock and Plainview, Texas; Fresno, Los Angeles, San Francisco, Phoenix, Albuquerque. Consult Your Local Telephone Directory.

PEERLESS PUMPS

fmc

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26, Los Angeles 31, California

Please send Bulletin No. B-2300 describing economical Fluidyne pumps.

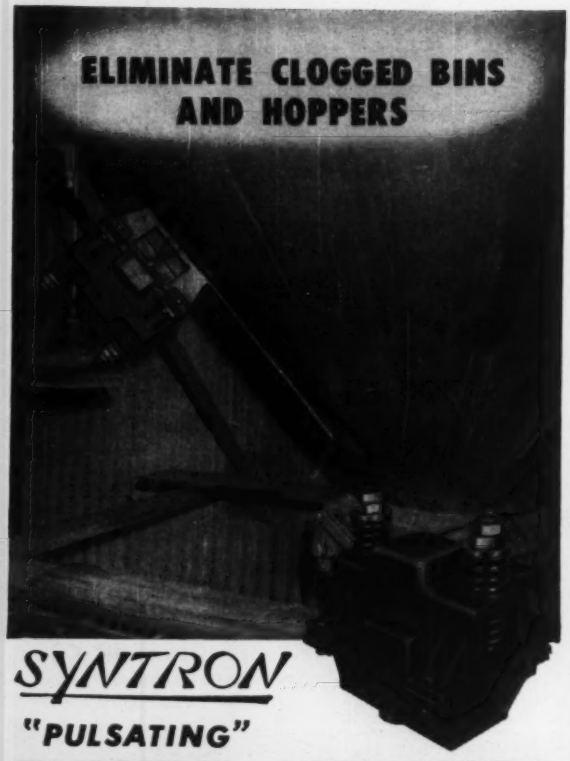
NAME_____

ADDRESS_____

COMPANY_____

CITY_____ STATE_____

ME



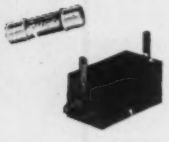
SYNTRON

"PULSATING"

ELECTRIC VIBRATORS

Powerful, pulsating electromagnets that bolt directly to troublesome hoppers — chutes — break up arching and plugging. They can be manually controlled – or automatically controlled by gate action, ON when the gate is open, OFF when the gate is closed.

. . . Other Syntron Equipment of proven dependable Quality



SELENIUM RECTIFIERS

For any product requiring a-c to d-c power conversion. Sizes from a small cartridge-type up to 12" x 16" plate.

INFRARED HEATING ELEMENTS

Most efficient units yet developed for industrial baking, heating and drying. They heat by direct radiation—not by reflection—no blind spots.

PARTS FEEDERS

For automatic, single file, oriented position feeding of parts at controllable rates.

Write For Free Catalogue Data

SYNTRON COMPANY
498 Lexington Avenue Homer City, Pa.

LATEST AMERICAN STANDARDS

Covering dimensions and tolerances, marking, materials, and other requirements for:

Pipe Flanges and Fittings, Pipe, and Pipe Threads

BUTT-WELDING ENDS FOR PIPE VALVES, FLANGES AND FITTINGS, B16.25—1955	$1.00
RING-JOINT GASKETS AND GROOVES FOR STEEL PIPE FLANGES, B16.20—1956	1.00
BRASS OR BRONZE FLANGES AND FLANGED FITTINGS, 150 AND 300 LB. B16.24—1953	1.00
BRASS OR BRONZE SCREWED FITTINGS—125 LB. B16.15—1947 (Reaffirmed 1952)	1.50
BRASS OR BRONZE SCREWED FITTINGS—250 LB. B16.17—1949 (Reaffirmed 1953)	1.00
CAST-BRASS SOLDER-JOINT FITTINGS, B16.18—1950	1.50
CAST-BRASS SOLDER-JOINT DRAINAGE FITTINGS, B16.23—1955	1.50
CI PIPE FLANGES AND FLANGED FITTINGS: 25 LB. PSI, B16b2—1931 (Reaffirmed 1952)	1.00
CLASS 125, B16.1—1948	1.50
CLASS 250, B16b—1944 (Reaffirmed 1953)	1.50
800 LB. HYDRAULIC PRESSURE, B16B1—1931 (Reaffirmed 1952)	1.00
CLASS 300 LB. REFRIGERANT PIPING, B16.16—1948 (Reaffirmed 1952)	1.00
CI SCREWED DRAINAGE FITTINGS, B16.12—1951	1.50
CI SCREWED FITTINGS, 125 AND 250 LB. B16.4—1949 (Reaffirmed 1953)	1.00
MALLEABLE-IRON SCREWED FITTINGS—150 LB. B16.3—1951	1.50
MALLEABLE-IRON SCREWED FITTINGS—300 LB. B16.19—1951	1.00
STEEL PIPE FLANGES AND FLANGED FITTINGS (150, 300, 400, 600, 900, 1500 AND 2500 LB.) B16.5—1953	3.00
FACE-TO-FACE DIMENSIONS OF FERROUS FLANGED AND WELDING END VALVES, B16.10—1939 (Reaffirmed 1947)	1.50
FERROUS PLUGS, BUSHING, AND LOCKNUTS WITH PIPE THREADS, B16.14—1949 (Reaffirmed 1953)	1.00
NONMETALLIC GASKETS FOR PIPE FLANGES, B15.21—1951	1.00
STEEL BUTT-WELDING FITTINGS, B16.9—1951	1.50
STEEL-SOCKET WELDING FITTINGS, B16.1—1946 (Reaffirmed 1952)	1.00
WROUGHT-COPPER AND WROUGHT-BRONZE SOLDER-JOINT FITTINGS, B16.22—1951	1.00
STAINLESS STEEL PIPE, B36.19—1952	1.00
WROUGHT-STEEL AND WROUGHT-IRON PIPE, B36.10—1950	1.00
PIPE THREADS, B2.1—1945	2.50

20% Discount to ASME Members

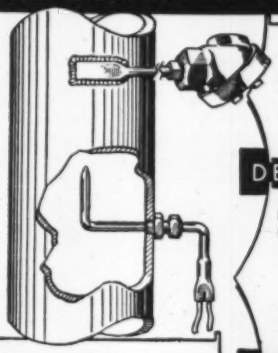
Published by
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39th Street New York 18

*SWAGED MGO

FOR OPERATING TEMPERATURES −300 to 2000°F

INSULATED THERMOCOUPLES



SURFACE with STANDARD T/C HEAD

- Extremely accurate since junction can be welded to surface.

DESIGNING

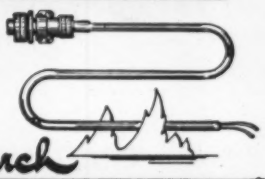
IMMERSION with LEAD WIRE ADAPTOR

- Fast time response.
- Install in any pipeline without a thermo-well by simply drilling and tapping.
- Pressure and vacuum tight.
- Variable immersion depth — easily replaced.

FABRICATING

LEAD WIRE with QUICK DISCONNECT

- Available in long lengths or spliced together to meet your length requirements.



*SWAGED MgO wire is available from our stock—Diam. .025 to 1/16". Send for Bulletin 4.

Aero Research

INSTRUMENT COMPANY, INC.

315 NO. ABERDEEN STREET • CHICAGO 7, ILLINOIS

Sales Representatives throughout the United States and Canada

MECHANICAL ENGINEERING

September, 1956 **CARD INDEX** **Vol. 78, No. 9**

Recent Advances in Food Techology, A. G. Olsen and D. A. Mills	802
Planning for Safety, R. W. Mallick	815
Why Is U. S. Industry Strong?, W. A. Hadley	820
Multifuel-Firing of Cyclone Furnaces, G. A. Watts and W. L. Sage	823
Remote-Control Handling Devices, Frank Ring, Jr.	828
High-Speed Problems of Large Airplanes, G. S. Schairer	832
Editorial	801
Briefing the Record	837
European Survey	850
ASME Technical Digest	854
Comments on Papers	868
Reviews of Books	871
Books Received in Library	872
ASME News	874
Roundup	890

LEFAX

TECHNICAL DATA BOOKS

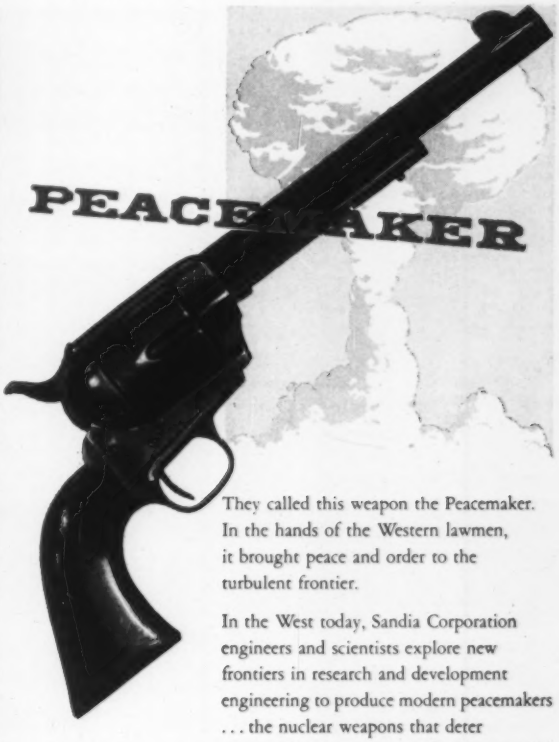
HANDY • POCKET SIZE • LOOSE LEAF

Printed on loose leaf, six hole, 6-¾" x 3-¾" bond paper, each book contains about 140 pages of technical data, presenting condensed, accurate and essential material for the engineer, technical worker, business man, student and teacher. **$1.25 each**

Architecture
Home Heating
Illumination
Electrician's Data
Builder's Data
Lumber Data
Air Conditioning
Building Construction
Reinforced Concrete
Piping Data
Surveying
Surveying Tables
Highway Engineering
General Math
Math Tables
Physics
Trig-Log Tables
General Chemistry
Chemical Tables
Analytic Chemistry
Mechanical Drawing
Machine Design
Machinist's Data
Mechanics of Materials
Power Transmission Machinery
Thermodynamic Tables & Charts
Physical & Thermodynamic Data
Metals
Metallurgy
Hydraulics
Radio
Television & FM
Electricity, AC
Electricity, DC
AC Motors & Generators
Transformers, Relays & Meters

Write for FREE catalog (over 2000 listings). See for yourself how helpful LEFAX can be to you. Send $1.25 for each book, or $6 for any five books listed above, to:

LEFAX PUBLISHERS **Dept. ME-3** **Phila. 7, Pa.**



They called this weapon the Peacemaker. In the hands of the Western lawmen, it brought peace and order to the turbulent frontier.

In the West today, Sandia Corporation engineers and scientists explore new frontiers in research and development engineering to produce modern peacemakers . . . the nuclear weapons that deter aggression and provide a vital element of security for the nations of the free world.

Sandia Corporation, a subsidiary of the Western Electric Company, operates Sandia Laboratory in Albuquerque, N. M. and a branch installation at Livermore, Cal. under direct contract with the Atomic Energy Commission. At both of these locations, engineers and scientists who look to the future find challenge and opportunity . . . the challenge of advanced problems in a broad range of research and development activities, and the opportunity for professional growth and individual advancement in a stimulating new field. In addition, they enjoy excellent living and working conditions, and outstanding employee benefits.

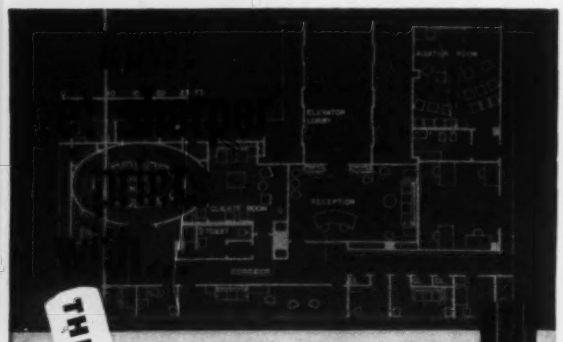
Qualified engineers and scientists interested in joining our professional staff are invited to write for further details.

Please address

STAFF EMPLOYMENT DIVISION 553.

SANDIA CORPORATION

ALBUQUERQUE, NEW MEXICO



THE LEAD THAT'S PERFECTLY UNIFORM FROM TOP TO BOTTOM

AMERICAN PENCIL CO. NEW YORK · VENUS · DRAWING · H

Venus always gives clearer, sharper prints because its lead is a perfect unvarying blend of finest quality clay and graphite.

It's homogenized. An exclusive Venus Patent called *the colloidal process*—actually a pressure explosion—assures the most thorough blending possible of the minute lead particles. There are no hard or soft spots . . . you get smudge-free tracings—no "ghosts". Erasures are easy to make.

Venus' lead is Pressure-Proofed—and this additional Venus secret seals the lead to the wood along the pencil's entire length. That's why a Venus is stronger . . . holds a needle point longer.

Venus drawing pencils are hand-graded—so you can depend on absolutely consistent accuracy of grading in all 17 degrees.

Use a holder? Try Venus Refill Drawing Lead.

Venus . . . trademark of fine craftsmanship in pencils

VENUS
drawing pencils

AMERICAN PENCIL COMPANY, Hoboken, N. J. ME-10-56
Please send me without obligation the Venus *Technical Test Kit.*

Name.....

Company Name.....

Address.....

HAMILTON STANDARD ENGINEERS

are reaching

new heights

WITH SUCH CHALLENGING PROJECTS AS

AIR CONDITIONING

"The MATADOR"

As high as the sky . . . the opportunities awaiting engineers right now at Hamilton Standard! Hamilton has already established a reputation for its work in the design, development and production of ingenious jet aircraft equipment. An *aviation engineering firm,* it has produced such products as fuel controls for America's most advanced jet aircraft, jet starters, air cycle refrigeration units, hydraulic pumps, and pneumatic valves. We would like to talk to you and point out the number of advantages to be had by working for Hamilton Standard.

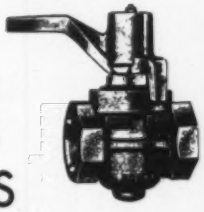
ENGINEERS for
DESIGN • CHECKING • DEVELOPMENT
METALLURGY • VIBRATION • ANALYSIS

Please send resume to Mr. W. H. Brownell at

HAMILTON STANDARD
DIVISION
UNITED AIRCRAFT CORPORATION
33 Bradley Field Road, Windsor Locks, Connecticut

Only DeZurik

MAKES THE EASY-OPERATING NON-LUBRICATED PLUG VALVES WITH ECCENTRIC ACTION!



LOOK TO DeZURIK

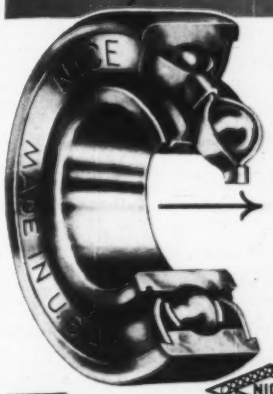
when you specify new or replacement valves.

Write for details.

Representatives in all principal cities.

DeZURIK SHOWER CO. Sartell, Minn.

NICE IS THE WORD FOR BEARINGS



The NICE line of ball bearings includes over 750 sizes and types of standard bearings and more than 2500 "specials". If a new "special" is the answer to the problem, NICE engineers can design a bearing that will be exactly right for the particular application.

Write for Cat. No. 130

NICE

NICE BALL BEARING CO.

NICETOWN • PHILADELPHIA • PENNSYLVANIA

IF YOU ARE ATTENDING THE

22nd NATIONAL EXPOSITION OF THE

POWER & MECHANICAL ENGINEERING SHOW

AT THE NEW YORK COLISEUM, NOV. 26-30

STAY AT THE HOTEL PARAMOUNT

CONVENIENTLY LOCATED TO THE COLISEUM

In just a few walking minutes . . you're at the Coliseum. And a few steps from the hotel . . all the city's theatres . . Radio City . . shops . . business . . sports and cultural centers. 700 modern, colorfully decorated single rooms and spacious suites. Each with private bath . . . each with radio. Fine restaurant. Coffee shop . . and Manhattan's unique "CURTAIN CALL" cocktail lounge.

Single from **$6** *to* **$10.** *Double* **$10** *to* **$15.**

HOTEL **PARAMOUNT**

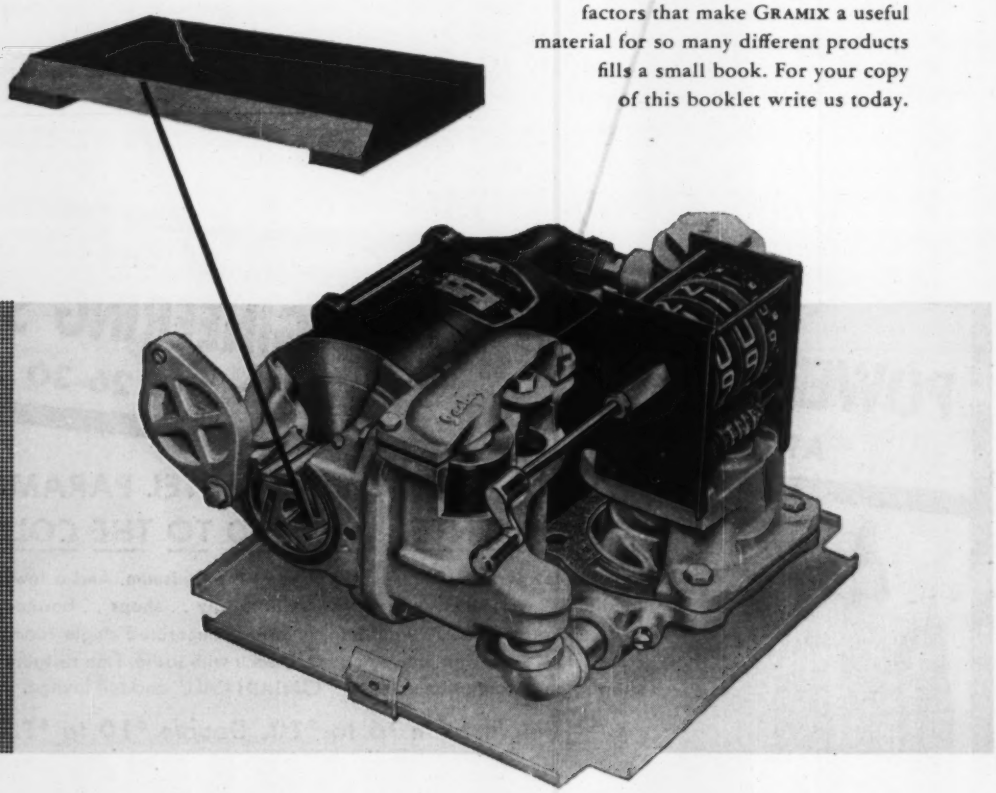
46th Street, just West of B'way, (Times Square), N.Y.

Charles L. Ornstein, General Manager (An Abbell Hotel)

GRAMIX® vanes in Gasboy® pump wear only .031" per ONE MILLION GALLONS

The Gasboy Super "200" gasoline pump is manufactured exclusively for farms, fleets, and industry by Wm. M. Wilson's Sons, Inc. in Lansdale, Pa. These pumps have proven to be accurate, efficient and dependable. But, what naturally interests us and will interest you, as a manufacturer or designer, are the GRAMIX vanes in these pumps. Tests reveal that the GRAMIX Grade 41 vanes still operated perfectly after pumping over 1,000,000 gallons of gasoline. During this endurance test, the vanes travelled around the inside of the housing a distance equal to 13,000 miles, or more than half way around the earth!

Not only these particular vanes, but hundreds of other GRAMIX parts are doing a successful job in appliances, aircraft, automobiles and an amazing variety of products. GRAMIX parts are die-pressed to close tolerances, and need no machining. They are strong, they are self-lubricating. The many factors that make GRAMIX a useful material for so many different products fills a small book. For your copy of this booklet write us today.



116

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

Opportunities

positions open • positions wanted • equipment, material, patents, books, instruments, etc. wanted and for sale • representatives • sales agencies • business for sale • partnership • capital • manufacturing facilities

ANSWERS to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

RATES: Classified advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.70 a line. $1.35 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display advertisements carried in single column units of multiples of one inch at flat rate of $28 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication

POSITIONS OPEN

NEW
in the
1957
MECHANICAL CATALOG:
Mechanical Engineers Recruitment Guide

Assistant Editor

—of long-established technical magazine in the field of general mechanical engineering. Must be graduate mechanical engineer with some practical engineering and editorial experience. Under 30 years of age, with ability to do original writing, rewriting, and abstracting, reporting and interviewing, and willing to travel. Location New York. Permanent position. Apply by letter with photograph, record of school and engineering work, references, and salary expected.

Address CA-5853, % "Mechanical Engineering."

SEE CHEMSTRAND'S AD ON PAGE 49 OF THIS MAGAZINE

Positions available for

ENGINEERS

(Chemical, Mechanical, Metallurgical, Textile, Industrial, Instrument and Civil) and

CHEMISTS

(Organic, Physical, Analytical—Instrumental and Wet Method, Textile Chemists.)

Write to Technical Personnel Department

THE CHEMSTRAND CORPORATION
Decatur, Alabama

Engineer, ME, EE

Nuclear Reactor Design for Aircraft

A long-range well-paid career position in the highly promising new field of aircraft nuclear propulsion, is now open with General Electric. This position will appeal to the qualified engineer whose creative fluency keeps him abreast of the many unusual design problems that he will encounter.

Requirements include a B.S. or advanced degree in mechanical or electrical engineering, plus familiarity with fluid flow, heat transfer, stress, etc. Some knowledge of fabrication processes and techniques is preferable.

Publication of research results in the appropriate classified or open literature is encouraged.

OPENINGS AT CINCINNATI, OHIO AND IDAHO FALLS, IDAHO

Address replies in confidence stating salary requirements to location you prefer

J. R. Rosselot
P. O. Box 132
Cincinnati, O

L. A. Munther
P. O. Box 535
Idaho Falls, Idaho

GENERAL ELECTRIC

HOW TO BE THE HAPPIEST CREATIVE ENGINEER IN CALIFORNIA

Engineers (E.E., M.E., Mfg., Sales) can have the kinds of jobs that creative men dream about. Top salaries and benefits. Suburban locations in Fullerton, Newport Beach, Richmond, or Palo Alto.

Write Beckman Instruments, Inc., 2999 W. 6th Street Los Angeles 5, California. Ask for Career File 55-10

SOHIO PIPE LINE COMPANY
has positions open for

CORROSION ENGINEER—B.S., M.S., experienced or interested in cathodic protection on bare and coated pipelines. Immediate location in Illinois, Indiana or Ohio.

CIVIL, ELECTRICAL, MECHANICAL ENGINEERS—for economic analysis, design and construction of crude oil and products pipelines, pump stations, tank terminals, communication systems. Immediate location in St. Louis, Missouri. Outstanding benefit programs. Salary commensurate with training and experience. Unusual opportunities for well qualified men. Give full particulars regarding education, experience, salary requirements and photograph. Replies held in strictest confidence.

William H. Weber
SOHIO PIPE LINE COMPANY
7438 Forsyth, St. Louis 5, Missouri

MECHANICAL ENGINEERS

The Record Speaks for Itself at Bendix

You can look forward, as in the past, to continued progress and expansion for many years to come at Bendix Utica Division.

Current openings are in design, development and production liaison work on aircraft accessories such as stators, generators pumps, and afterburner and de-icing equipment etc.

Now and in the future you can count on salaries among the highest in industry and especially favorable working conditions in the new Utica plant.

Utica itself is a fine place to live. Located at the head of the historic Mohawk Valley just minutes from the beautiful Adirondack Mountains, it is easily reached by plane, train and the N.Y. State Thruway. Recreational and educational facilities are good; nice homes on tree-shaded streets are abundant.

If you are looking for peaceful living . . . AND a top notch job with a leader in industry, write details of your experience to D. C. Pontius.

Bendix UTICA DIVISION
AVIATION CORPORATION

211 Seward Ave. Utica, New York

ENGINEERS FOR IMMEDIATE PLACEMENT

- **Electrical engineers**
- **Mechanical engineers**
- **Electronic engineers**
- **Computer engineers**
- **Solid-state physicists**

ENGINEERING AT NCR MEANS:

IMMEDIATE, PERMANENT POSITIONS in Mechanical Engineering, Electrical Engineering and Physics Research Division.

ENGINEERING PROJECT WORK in Adding Machines, Cash Registers, Accounting Machines, Computers and related Data Processing Equipment in Dayton, Los Angeles and Ithaca, New York.

OPPORTUNITIES IN DESIGN, development, production-engineering and packaging of mechanical, electronic and electro-mechanical devices.

SOME EXPERIENCE IN DEVELOPMENT, design and application of high-speed, light-weight mechanisms of the intermittent-motion type—or experience in digital devices and components is desirable, but not essential.

AMPLE TRAINING and orientation is available to all employees.

ENGINEERS

AS AN NCR ENGINEER, YOU WITH YOUR FAMILY, WILL ENJOY:

UNLIMITED OPPORTUNITY in the broad, ever-expanding field of Business Machine Engineering and Research.

AN EXCELLENT SALARY, plus exceptional benefits of lifetime value for you and your family.

A RECREATIONAL PROGRAM for year-round enjoyment for the entire family, including a new NCR Country Club with 36 holes of golf, and a 166-acre employees' park for outings with swimming, boating and supervised play for children.

LIVING IN DAYTON—an attractive, progressive city with outstanding school facilities.

YOUR WORK AT NCR with its friendly, family atmosphere, where you work with people who, like yourself, have decided to build their professional future with NCR.

ACT AT ONCE

Send resume of your education, experience and geographic preference to:

Employment Department,

Professional Personnel Section 2

THE NATIONAL CASH REGISTER COMPANY • DAYTON 9 • OHIO

There is a case for Changing Jobs . . .

MANY highly qualified technical men find that the work available to them in their present assignment does not give the opportunity to make maximum use of skills and knowledge acquired through years of work and study.

When a man reaches this point in his development, there are two courses open to him. He can seek reassignment or he can change employers, going to a position that will give him more room to grow.

If a transfer seems unlikely in your case, it may be to your advantage to consider the alternative and investigate the exceptional openings available to qualified engineers at Chance Vought.

Here, you will find a medium-sized engineering organization with modern technical facilities and creative engineering assignments available in the newest phases of aeronautical research and design of fighter aircraft and guided missiles.

Currently Chance Vought is producing a 1000-plus-mile-per-hour Navy fighter — the F8U-1 "Crusader" — and the guided missile "Regulus." Further development of these as well as other challenging classified projects assures qualified men of outstanding personal opportunities. For a full evaluation of the future open to you at Chance Vought, investigate these opportunities today.

Openings exist at present for all levels of experience in:

AIRFRAME DESIGN
(Fuselage, Wing and Tail)

MECHANICAL DESIGN
(Equipment and Engine Installation, Electrical and Hydraulics Systems, Landing Gear, Controls, and Armament)

STRUCTURES
(Stress Analysis, Testing, Materials, Metallurgy)

AERODYNAMICS
(Air Loads, Stability and Control, Heat Transfer, Performance Prediction)

PROPULSION ANALYSIS
(Installed Engine Performance, Heat Transfer, Duct Design)

ELECTRONICS SYSTEMS DESIGN
(Automatic Controls and Guidance, Advanced Systems Development, Reliability and Packaging)

FLIGHT TEST
(Planning, Operation, Analysis and Instrumentation)

TOOLING
(Tool Planning, Tool Design, Tool Research)

To arrange for a personal, confidential interview

WRITE **Engineering Personnel, Dept. 10-2**

CHANCE VOUGHT AIRCRAFT
INCORPORATED

P. O. Box 5907 • Dallas, Texas

Trailblazers

MARQUARDT
BREAKS
NEW
FRONTIERS
WITH
BOMARC
POWERPLANT

NEW OGDEN
FACILITIES
BOOST
NATION'S
DEFENSE

Marquardt AIRCRAFT CO.

Marquardt's research center is fast becoming one of this country's creative engineering capitals. Unlimited opportunities at Van Nuys are attracting many Research and Development engineers to Marquardt.

Write for details:

PROFESSIONAL PERSONNEL
16555 Saticoy Street, Van Nuys, California

THE WEST'S LARGEST JET ENGINE RESEARCH AND DEVELOPMENT CENTER

SALES ENGINEERS WANTED

Excellent opportunities for engineers with well established East Coast Industrial Manufacturer now expanding branch office coverage.

Electrical, Mechanical, or Electronic Engineers preferred.

Openings in Oregon, San Francisco, St. Louis, and Detroit.

Generous company paid benefits include hospitalization, pension, insurance, and vacation plans.

Address CA-5940, % "Mechanical Engineering."

MECHANICAL ENGINEERS

Several excellent opportunities available with major producer of synthetic fibers and films. Openings are current in plant engineering departments in Pennsylvania, Virginia, and West Virginia.

Graduate mechanical engineers with 0–5 years of experience in machine and equipment design, mechanical layout, engineering maintenance, or related activities are invited to reply.

Please send resume including details of education, experience, and salary requirements to:

Personnel Recruitment Department
AMERICAN VISCOSE CORPORATION
1617 Pennsylvania Boulevard
Philadelphia 3, Pennsylvania

ENGINEERS—PHYSICISTS

OPPORTUNITIES IN OPERATIONS RESEARCH

THE JOHNS HOPKINS UNIVERSITY

Operations Research Office

offers exceptional opportunities for *ENGINEERS* and *PHYSICISTS* who desire the challenge of military operational problems of unusual scope and diversity to routine design and development work.

Our current research program under a contract with the Department of the Army includes problems in tactics, strategy, weapons systems, intelligence, communications, logistics and military applications of game theory. Studies in these areas are normally carried on by mixed teams of scientists, each of whom is expected to contribute as a specialist to a synthesized solution.

- Selected opportunities for two-year overseas assignments in Germany or Japan.
- Liberal employee benefits and leave privileges.
- Rapid advancement for demonstrated capabilities.
- A competitive salary scale.

Please send your resume to:
Dr. Lincoln Hanson
Research Personnel Office
7100 Connecticut Avenue
Chevy Chase 15, Maryland

PROCESS ENGINEER

A chemical or mechanical engineer with at least five years' industrial experience, to analyse technological, economic and procedural problems in the manufacture of pulp and paper. An opportunity for significant achievement. Salary open.

Apply to Personnel Dept.

WEST VIRGINIA PULP AND PAPER COMPANY

230 Park Avenue New York 17, N. Y.

MECHANICAL ENGINEER

Opportunity in San Francisco Bay Area with leading petroleum research organization for engineer under 30 with BS or MS and strong interest in research in the field of lubrication. Experience is not necessary. Please send personal and work background information to:

Employment Supervisor

SHELL DEVELOPMENT COMPANY

Emeryville 8, California

GOODYEAR ATOMIC CORPORATION POSITIONS NOW OPEN IN PLANT ENGINEERING PRODUCTION — DEVELOPMENT FOR

ENGINEERS
CHEMISTS
TECHNICAL WRITERS
METALLURGISTS
STATISTICIANS
PHYSICISTS

POSITIONS OPEN ON SEVERAL LEVELS OF RESPONSIBILITY FORWARD COMPREHENSIVE RESUME TO:

EMPLOYMENT DEPARTMENT C
GOODYEAR ATOMIC CORPORATION
BOX 628, PORTSMOUTH, OHIO

DESIGNERS

...if YOU are interested in MORE than "just a job"

DU PONT is interested in YOU!

To a designer who seriously wants to grow in his field,
Du Pont Offers Real Opportunity.

Work on interesting, challenging, professional assignments. Du Pont's vast research program assures diversification. Your assignments will include work in synthetic fibres, heavy chemicals, pigments, finishes, plastics, photo products, electrochemicals and many other fields.

Progress and promotion are commensurate with ability and performance.

Comprehensive and varied training programs to develop both technical and administrative abilities.

Promotion-from-within. This, plus continuous Company growth, assures both excellent advancement opportunities and stability.

Progressive benefit programs provide immediate and long-term security — majority company-paid.

APPLY NOW to fill one of these immediate openings for:

PROCESS DESIGNERS
PROCESS EQUIPMENT DESIGNERS
MECHANICAL DESIGNERS
INSTRUMENT DESIGNERS
POWER DESIGNERS

Please send complete resume, including details of education and experience, to:
Mr. T. J. Donovan
Engineering Department

DU PONT
REG U.S. PAT. OFF

Better Things for Better Living
. . .through Chemistry

E. I. du Pont de Nemours & Co., Inc.
Wilmington 98, Delaware

OMAR

Engineers in training... Experienced engineers...

... there's no limit to the opportunities open to you as members of the OMAR team in the fields of:

Rocket and Ramjet Engines
Propellants and Fuels
Testing and Evaluation

Positions are open for the following:

mechanical engineers
combustion engineers
aeronautical engineers
stress analysts
turbine engineers
thermodynamicists
servo engineers
electrical engineers
nuclear engineers
ordnance engineers
instrumentation engineers
test engineers
development engineers
process design engineers
production engineers
physicists
mathematicians
organo-metallic specialists
inorganic chemists
organic chemists
polymer chemists
electrochemists
physical chemists
analytical chemists

On the OMAR team, you're affiliated with pioneers in the field of supersonic propulsion: **Reaction Motors, Inc.**, first in the American rocket industry; **Marquardt Aircraft Company**, the West's largest jet research and development center and first in ramjets; **Olin Mathieson Chemical Corporation**, a leading producer of chemicals, metals, explosives, and high-energy fuels.

You're on a team that unites for the first time both chemical and mechanical experience in research, development, and production of supersonic rockets, ramjets, and liquid and solid propellants.

For further information write *OMAR Employment Officer* at the company nearest you.

Olin Mathieson Chemical Corporation
466 Park Avenue, New York 22, N. Y.

Reaction Motors, Inc.
Denville 4, New Jersey

Marquardt Aircraft Company
16557 Saticoy Street
Van Nuys, California 3907

Erie Mining Company, in the heart of the Arrowhead where there is excellent hunting and fishing, is considering applications for a Plant Engineer.

Applicant should have ME Degree with at least ten years' experience on mech. struct. and elect. design, as well as supervision of other engineers. Excellent housing, schools, churches, insurance and pension benefits.

Send complete resume and salary desired to:

Mr. H. P. Brown
Industrial Relations Dept.
Box 847, Hoyt Lakes, Minnesota

MECHANICAL ENGINEER

Graduate mechanical engineer in power plant design work. Experience not required. Excellent opportunity with consulting engineering firm in the Middle West. Liberal benefit plans and good working conditions.

Send resume of education and experience with statement of salary requirements.

Address CA-5905, % "Mechanical Engineering."

MECHANICAL DESIGNERS

Heavy Industrial

Kaiser Engineers will bring YOU to California

Why put up with sweltering summers, freezing winters, huge heat bills, coolie labor shoveling snow! Move now to San Francisco Bay Area's bright smog-free sunshine, temperate climate. Indoor-outdoor living, new schools and shopping centers, beach and mountain recreation close by. Plus prequisites you deserve—insurance, hospitalization, moving allowance, etc.

All this is yours if you have an ME and 3 years in material handling equipment, heavy industrial plant layout.

IT'S WORTH INVESTIGATION! WRITE TODAY IN STRICTEST CONFIDENCE STATING SALARY DESIRED.

KAISER ENGINEERS
Division of Henry J. Kaiser Co.
Dept. RV 1924 Broadway
Oakland 12, California

SALES ENGINEERS

Leading bottling and packaging machinery manufacturer has several openings for qualified Sales Engineers in various locations in U.S.A. These positions offer excellent future and top compensation. Travel and hard work a requirement.

If you are familiar with the brewing, carbonated beverage, food, liquor or chemical industries and a graduate engineer with previous sales experience, please send complete resume.

All replies will be held in strictest confidence. Personal interview will be arranged.

Address CA-5945, % "Mechanical Engineering."

ENGINEER

Does your present position contain any elements of these activities?

- **Mechanical Development**
- **Hydraulic and Servo Systems Design**
- **Stress and Vibration Analysis**
- **Instrumentation Engineering**

A few openings for engineers with experience in these areas and the ability to apply their basic knowledge effectively to concepts in advanced engine design and development.

These opportunities are outside the usual run of engineering positions, with well defined promotional possibilities in a department of a long-established company, where expansion has been continuous. Remuneration is commensurate with the advanced nature of the assignments. The engineer is accorded high professional status and there are additional benefits of satisfying nature. The product offers stability in its appeal to both commercial and military markets.

Please write in complete confidence to:
Mr. T. S. Woerz (Section 5-B)
SMALL AIRCRAFT ENGINE DEPT.

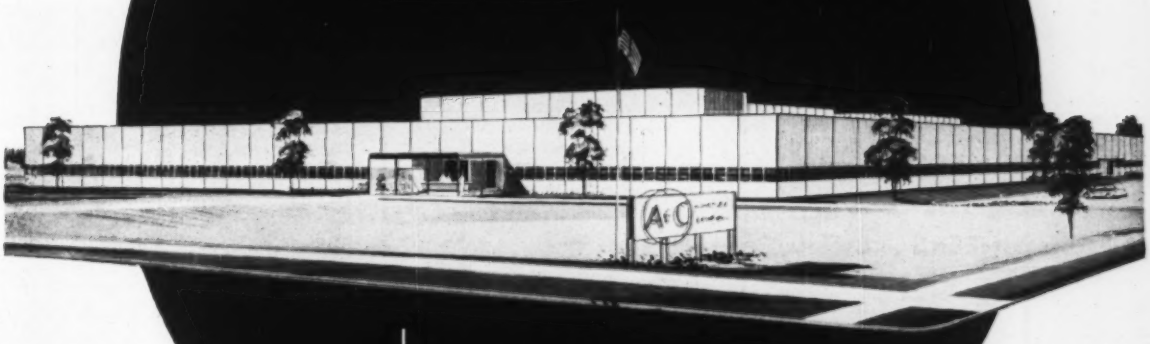
GENERAL ELECTRIC

1000 Western Avenue, West Lynn, Mass.

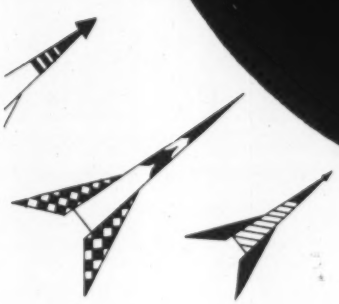
ENGINEERS

AC OFFERS YOU SECURITY

G M's long-standing policy of decentralization creates unlimited opportunities for qualified Electrical, Mechanical Engineers and Engineering Technicians.



DEVOTED TO RESEARCH



AVIONICS – MISSILE GUIDANCE – JET ENGINE FUEL CONTROLS – COMPUTERS – COMMUNICATION EQUIPMENT – CIVIL DEFENSE AVIATION – AUTOMOTIVE ELECTRONIC PRODUCTS all offer you personally, opportunities that demand investigation. To arrange personal, confidential interview in your territory, write today to

Mr. John F. Heffinger,
Supervisor of Salaried Personnel.

AC'S new, modern 225,000 square feet, glass-masonry, aluminum plant (being built in suburban Milwaukee) is another step in GM's Electronics Division's Permanent, Progressive Program.

For a confidential opinion as to how YOU can fit BEST in our Challenging Program write to us today.

AC THE ELECTRONICS DIVISION

General Motors Corporation

Milwaukee 2, Wisconsin • Flint 2, Michigan

At
RCA
your
M.E. degree
can bring you
up to $10,000
plus future
advancement

INTERMEDIATE MECHANICAL ENGINEERS . . .

Mechanical design and development of military weapons systems (antennas, pedestals, computers, gear trains, precision mechanical devices).
These creative positions have more than usual growth potential.
The right men can advance to Senior Engineers' responsibilities!
Suburban Philadelphia, at Moorestown, N. J.

•

FOR CONFIDENTIAL INTERVIEW

Call Collect—Mr. R. A. Wallace
At Camden, N. J.
WOodlawn 4-7800

Or, send resume to:
Mr. John R. Weld
Employment Mgr., Dept. V-3K
Radio Corporation of America
Camden 2, N. J.

RADIO CORPORATION OF AMERICA

PIPING & AIR CONDITIONING DESIGNERS & DRAFTSMEN

Long established firm of consulting engineers with worldwide practice needs piping and air conditioning designers and draftsmen for work on hydro powerplants. Five years' experience preferred. Permanent positions. Liberal employee benefits. Starting salaries dependent on qualications. Please send complete resume to

Personnel Department
HARZA ENGINEERING COMPANY
400 West Madison Street, Chicago 6, Illinois

Mechanical Engineer

Facilities

To perform design work on facilities for research and development. Positions available at all levels. Experience required in the following fields: air conditioning and ventilation systems for industrial plants, piping systems for mechanical utilities.

Will perform design investigation, calculation and direct the work of designers in preparation of plans and specifications for new and modified facilities.

Please send replies in confidence, stating salary requirements, to:

Mr. J. R. Rosselot
Aircraft Nuclear Propulsion Dept.

GENERAL ELECTRIC
P. O. Box 132 **Cincinnati 15, Ohio**

PIPING ENGINEERS

Qualified piping engineers and designers, preferably with 5 years experience or more, can broaden their professional responsibilities with C F Braun & Co. The work is on engineering and design of complete integrated petroleum refineries and petrochemical plants, many types of individual process units, and power plants.

Assignments include arrangement of plant equipment and facilities, layout of process and utilities piping, stress analysis of piping systems, design of spring supports, and preparation of specifications for piping materials and insulation.

Top salaries. Fine facilities. Profit-sharing retirement plan. Write to the head of our Personnel Department, Mr F B Stratford.

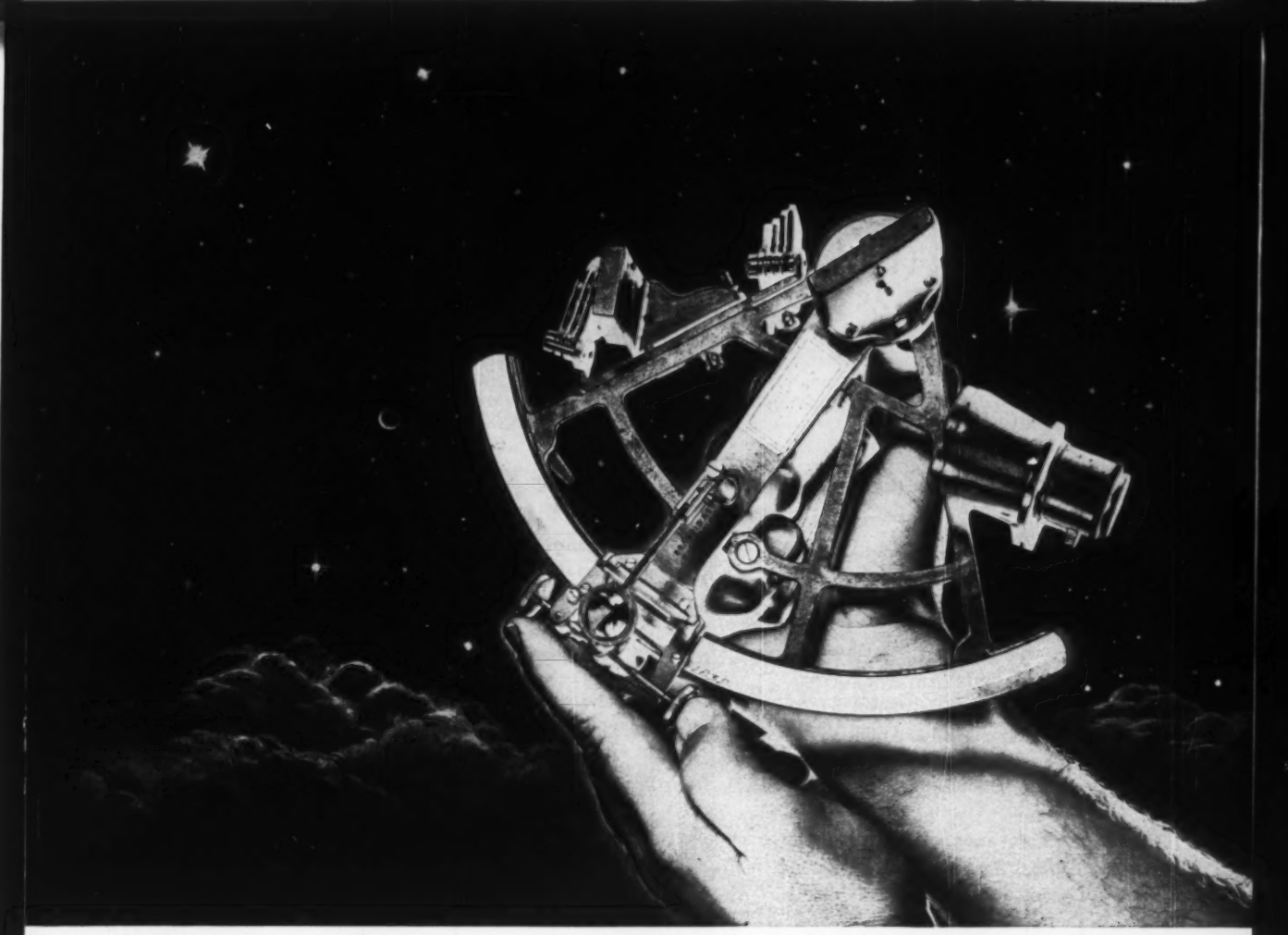
C F BRAUN & CO
ALHAMBRA CALIFORNIA
Engineers
Consultants Constructors

MAINTENANCE ENGINEERS
PLANT EQUIPMENT INSPECTORS

For openings in new Chemical Maintenance Engineering Section of Pittsburgh Coke & Chemical Company, a growing, medium size, organic chemical producer.

Graduate engineers in Metallurgical, Chemical, Mechanical or Industrial Engineering, (or equivalent), having 0 to 10 years' experience in Chemical Plants or Petroleum Refineries, write or call immediately:

Carl D. Thomas, Supervisor
Maintenance Engineering
PITTSBURGH COKE & CHEMICAL COMPANY
Neville Island
PITTSBURGH 25, Pennsylvania
Spalding 1-4400



UNIVAC® and your stars...

What are you shooting for in the vast universe of opportunity? Remington Rand UNIVAC has a majority of the top men in computer development . . . men who brought into being the basic knowledge in this field . . . who set the standards others follow . . . and who consistently lead in design trends today. These men will share their know-how wisely with you.

UNIVAC offers permanent positions in

Electro-Mechanical Engineering • Design • Product Design

IMMEDIATE OPENINGS FOR

MECHANICAL ENGINEERS: Graduates BS and MS levels. For development of automation instruments . . . computer input and output mechanisms . . . memory devices. Includes paper and magnetic tape handling equipment, punched card equipment, printer, magnetic storage drums, and machine design in mechanical and electro-mechanical fields in our South Norwalk plant.

In our St. Paul location, openings for mechanical engineers are for development engineering work in computer input mechanisms consisting of cards, tapes and keyboard devices, computer memory devices and high speed output printing mechanisms. Will design cabinet structures, component packaging, cooling and ventilating systems and miniaturized components.

Send Complete Resumé to

REMINGTON RAND UNIVAC

FRANK KING
Dept. NO-4
Wilson Avenue
South Norwalk, Conn.

J. N. WOODBURY
Dept. SO-4
1902 W. Minnehaha Ave.
St. Paul W4, Minnesota

Remington Rand Univac

DIVISION OF SPERRY RAND CORPORATION

® Registered in U. S. Patent Office

Salaries for Engineers

An engineer's salary is determined by more than just his ability

All too often, ability and salary are shackled by lack of opportunity for promotion. For that reason, you'll be interested in Lockheed's diversified expansion program. Forty to fifty major projects are in progress continuously. Commercial and military activities cover virtually all phases of aeronautical endeavor.

The breadth and scope of this program means engineers have exceptional opportunity for promotion at Lockheed—simply because there are more supervisory positions to be filled with so many projects constantly in motion.

If your salary reflects lack of opportunity for promotion, why not look into opportunities presented by Lockheed diversification. It's worth discussing. Write or phone collect, if you possess an engineering degree or actual engineering experience. Address written inquiries to E. W. Des Lauriers or use the brief resumé form below. If you phone, call STanley 7-1241, Extension 6-2134.

To engineers who lack aircraft experience:
Aircraft experience is not necessary to join Lockheed. It's your engineering training and experience that count. Lockheed trains you for aircraft engineering—at full pay.

Advanced education program for engineers:
You can expand your technical knowledge and achieve advanced degrees through a variety of Lockheed-sponsored university programs that cost you little or nothing.

Positions are open on virtually all levels in fields of:

AERODYNAMICS
FLIGHT TEST ENGINEERING
MATHEMATICAL ANALYSIS
OPERATIONS RESEARCH
STRUCTURES
THERMODYNAMICS
WEIGHT

DESIGN
in controls, electrical, hydraulics, mechanical, power plant and structures areas.

ELECTRONIC SYSTEMS
in communications, countermeasures, fire control, navigation, radar and antenna design.

Lockheed Salary Facts

In the last three-and-a-half years Lockheed engineers have received blanket increases totaling 19%. This is in addition to merit increases granted engineers for individual achievement and promotion.

E. W. Des Lauriers, Dept. SE-4-10
Lockheed Aircraft Corporation, Burbank, California

Dear Sir:
Please send me your brochure detailing life and work at Lockheed.

Name

If you are an engineer, please state your field of engineering

Home street address

City and State Home phone

Lockheed

AIRCRAFT CORPORATION
California Division
BURBANK, CALIFORNIA

DU PONT NOW OFFERS

SIX CAREER POSITIONS OF CHALLENGE AND RESPONSIBILITY FOR SPECIALIZED MECHANICAL ENGINEERS.

The Engineering Service Division of du Pont's Engineering Department provides consulting service and technical assistance to production, maintenance, design, research, and construction groups within the company. The Division's objectives are to assist other company units in improving plant efficiency and product quality, in reducing investment and operating costs, and in increasing capacity. Six openings are immediately available for experienced graduate engineers to provide consulting service to operating plants in the following specialized mechanical engineering fields:

MATERIALS HANDLING

This position requires three to ten years' experience with bulk or package handling systems and equipment. The successful applicant will be expected to have engineering knowledge of belt conveyors, bucket elevators, screw conveyors, storage bins, chutes, hoppers, and feeders. Familiarity with pneumatic conveyors or mobile handling equipment is desirable. Duties include providing consultation on existing equipment, selection of new equipment, making cost studies, and development and execution of major materials handling engineering programs.

EQUIPMENT IMPROVEMENT

Position requires 5 or more years' engineering experience in research, development, design, application, or maintenance of chemical process equipment and machines. Duties include: Conducting mechanical engineering studies on chemical plant problems involving equipment design, mechanisms, machine components, and machine drives; and analyzing and solving problems in selection, operation, and maintenance of chemical process plant equipment. Qualifications should include sound practical knowledge of engineering economics, machine design fluid mechanics, or applied mechanics.

POWER

Position requires extensive practical power experience including operation and maintenance of industrial steam power plant facilities and equipment testing. Some experience in steam plant design and construction or in thermal insulation of process piping and equipment is desirable. Duties include: making economic valuations and involved heat balances for complicated power systems; assisting in specification of power equipment and in selection of new facilities; and determination of causes of equipment malfunctioning and development of recommendations for corrections.

MAINTENANCE ENGINEERING

Position requires five or more years' responsible experience on a supervisory or staff level in plant maintenance organizations, planning work, estimating manpower and material requirements, scheduling and controlling work, and accounting for the expenditure of maintenance funds. Successful applicant will consult on preventive and corrective maintenance problems such as: improved procedures and methods, training programs, machine tools and other maintenance equipment, plant maintenance organization, welding, and other related phases of plant maintenance.

AIR CONDITIONING

A graduate engineer with 5 or more years' experience in the selection and operation of heating, air conditioning, ventilating, and refrigeration equipment. The successful applicant will provide consultation to operating plants and to design and construction groups on the evaluation and economic operation of such equipment. Duties will require a broad and detailed knowledge of heating methods and systems, fans, building heat transmission, automatic controls, air cleaning devices, spray apparatus, sorbent materials, refrigeration, air duct design, exhaust and conveying systems, drying systems, health aspects of ventilation, piping and insulation, instruments and measurements, and investment and operating costs.

PUMPS AND FLUID MECHANICS

Desired qualifications will include extensive engineering knowledge of and familiarity with equipment used in the fluid mechanics field. Development, research, design, maintenance, or teaching experience with pumps, compressors, jets, and seals is desirable. Responsibilities of the position will involve selection of equipment, trouble-shooting, and consultation on fluid flow and mechanical design aspects of piping, pumps, jets, compressors, and seals. Duties include evaluation of available equipment and recommendations for equipment modification for special applications.

NEW YORK INTERVIEWS
Sun-Mon-Tues-Wed, Nov. 25-26-27-28
To arrange an appointment with our technical representative, please call
Mr. K. S. Marlin, Jr.
PEnnsylvania 6-5096

BOSTON INTERVIEWS
Sun-Mon-Tues-Wed, Dec. 9-10-11-12
To arrange an appointment with our technical representative, please call
Mr. K. S. Marlin, Jr.
Hancock 6-2044

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

Or you may send complete resume, including details of education and experience, to:

Mr. K. S. Marlin, Jr.
Engineering Department

E. I. du Pont de Nemours & Co., Inc.

Wilmington 98, Delaware

DESIGNERS

WHERE do you start training for promotion from your first day on the job?

For the answer, turn to page 169

MECHANICAL ENGINEERS

Mechanical Engineers with 3 to 10 years' experience in central station power plant design. Permanent position with fine opportunity for advancement. Comprehensive fringe benefits. Write stating education, experience and salary desired. Duke Power Company; Employment Office, P.O. Box 2178; Charlotte, N. C.

GUIDED MISSILE RESEARCH and DEVELOPMENT

Positions open for men with 0–4 years' experience

MECHANICAL or CHEMICAL ENGINEER, or PHYSICIST (advanced degree or equivalent experience) to do fundamental research in interior ballistics.

B.S. MECHANICAL ENGINEES with inspection or machine shop experience to supervise Components Inspection Group.

B.S. or M.S. MECHANICAL, CIVIL or ELECTRICAL ENGINEERS to plan and complete mechanical design phases of rocket component research.

CHEMICAL ENGINEERS, PHYSICISTS, MATHEMATICIANS (B.S., M.S., or Ph.D.) for applied ballistics research work.

B.S. or M.S. CHEMICAL ENGINEERS to do design and development work on rocket components.

Write to **EMPLOYMENT OFFICE**

HERCULES POWDER COMPANY
ALLEGANY BALLISTICS LABORATORY
Cumberland, Md.

MECHANICAL and CIVIL ENGINEERS:

There are outstanding career opportunities with one of the 100 largest corporations in the United States for men with the following qualifications:

- **One to five years experience in petroleum refining or related activities.**
- **B.S. or M.S. degree and experience in process equipment construction, design, inspection, or maintenance, petroleum product testing and field evaluation, or related work background.**
- **Age range . . . 22-32.**

Choice positions open in Cleveland, Toledo and Lima, Ohio.

Write, giving a complete resume of your education, experience and personal data to:

CLYDE A. BRUGGERS
1737-D Midland Building, Cleveland 15, Ohio

There's a bright future waiting for the right men with

THE STANDARD OIL COMPANY (OHIO)

Aero-dynamicist... to $10,500 in this stimulating missile test work

You will be challenged by the problems involved in analysis of long range missile performance from data acquired through external and internal instrumentation. Master's degree plus courses in theoretical aerodynamics, trajectory analysis, advanced calculus and theory of flight.

•

Join a scientific team at top level in this unprecedented work with a world leader in electronics. Ideal living conditions on Florida's Central East Coast.

•

To arrange confidential interview, send resume to Mr. H. C. Laur, Dept. N-6J
Missile Test Project
P. O. Box 1226
Melbourne, Florida

In ENGINEERING the best OPPORTUNITIES are in AVIATION

In AVIATION the best OPPORTUNITIES are at TEMCO

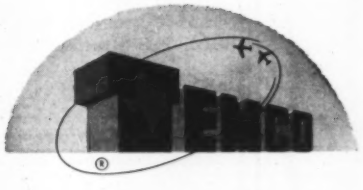
DYNAMICS — Flutter and Vibration Analysis

DESIGNER — Landing Gear, Hydraulics, Power Plant and Airframe

TEST ENGINEERS — Structural, Servo

ENGINEERS — Electronics, Environmental, Materials & Processes, Structures, Structural Analysis & Design, Aerodynamics, Material Review, Liaison, Loftsman

Write: J. W. Russell, Engineering Personnel, Dept. 170-C, Temco Aircraft Corp., Box 6191, Dallas, Texas



AIRCRAFT CORPORATION • DALLAS

engineers . . . physicists

NEW opportunities at MOTOROLA in Phoenix

WORK IN A VACATIONLAND

(your family will love year-round outdoor living)

WHILE YOU ADVANCE YOUR CAREER

Here are two of the country's newest and most complete Electronic Laboratories; (1) our expanding Military Research lab. and (2) our new Semi-Conductor Division. Both offer outstanding career advantages . . . (see listing below). This is your opportunity to get in on the ground floor of a swiftly expanding company. You'll enjoy working in air conditioned comfort in the most modern and well instrumented laboratories . . . with liberal employee benefits, including an attractive profit sharing plan and association with men of the highest technical competence.

Salary levels are open and commensurate with ability. You'll like working with Motorola in Phoenix, where there's room to grow and it's fun to live.

MOTOROLA IN PHOENIX HAS OPENINGS FOR:

Electronic Engineers, Mechanical Engineers, Physicists, Metallurgists, and Chemists, in the following categories:

Research Laboratory	Semi-Conductor Division
Microwave Antennas	Transistor Application
Pulse and Video Circuitry	Transistor Devices
Radar Systems Design	Solid State Physics
Circuit Design	Physical Chemistry
Electro-Mechanical Devices	Metallurgical Engineering
Systems Test	Production Engineering
Transistor Applications	Transistor Sales Engineering
DRAFTSMEN.....	.....Electrical Design and Layout

for above positions write to:

Mr. R. Coulter, Dept. E
3102 N. 56th St.,
Phoenix, Ariz.

for above positions write to:

Mr. V. Sorenson, Dept. E
5005 E. McDowell Rd.,
Phoenix, Ariz.

Excellent opportunities in RIVERSIDE & CHICAGO, too

RIVERSIDE, CALIF., Exceptional openings in Military Operation Analysis, Analog Computor Flight Simulation, Digital Computor Analysis, Microwave Systems, Servo Mechanisms, Missile Systems, Aerophysics.

Write to:

Mr. C. Koziol, Dept. E
P O Box 2072
Riverside, California

CHICAGO, ILL., Challenging positions in Two-Way Communications, Microwave, Radar and Military Equipment, Television (Color), Radio Engineering, Field Engineering, and Sales Engineering.

Write to:

Mr. L. B. Wrenn, Dept. E
4501 Augusta Blvd.
Chicago 51, Ill.

MOTOROLA

M.E., E.E. PHYSICISTS OPPORTUNITY

Rapidly Expanding Chemical Company Leader in the Field

Excellent opportunity for recent graduate, M.E.'s and E.E.'s as trainees in Service Engineering. Must have growth potential for managerial positions. East Coast location of multiplant company.

Openings for Physicists or Electronic Engineers. Work involves testing of military devices, instrumentation for testing, design and maintenance of electronic equipment, mechanical design of instrumentation parts: Work is largely experimental in nature. Applicant should be interested in research.

Send resume.

Address CA-5908, % "Mechanical Engineering."

REFINERY ENGINEERING in Southern California

Several qualified graduate engineers – Chemical, Mechanical or Petroleum – can broaden their professional responsibilities in our Chemical Engineering Department.

Assignments will cover the application of processes to a wide variety of industrial plants, ranging from complete integrated refineries and chemical processing centers through all types of individual process units. The work includes coordination of chemical engineering, the selection and design of process equipment and machinery, and startup of completed plants.

Top salaries, fine facilities, profit-sharing retirement plan. Write to the head of our Personnel Department, Mr F B Stratford.

C F BRAUN & CO
ALHAMBRA CALIFORNIA
Engineers
Consultants Constructors

RESEARCH ENGINEERS

We offer a challenge to high calibre men interested in making their careers in research. This is an organization with a specific purpose—RESEARCH. We need creative self starters—our business is based on ideas that are generated and carried through to conclusions. We have excellent positions in these fields:

Heat Transfer
Fluid Mechanics
Thermodynamics
Hydrodynamics

Send us your resume today because in addition to the interesting and challenging opportunity to work with leading engineers, we offer excellent employee benefits, good salaries, and tuition free graduate study. Please write

Mr. J. A. Metzger
ARMOUR RESEARCH FOUNDATION
of
Illinois Institute of Technology
10 West 35th Street
Chicago, Illinois

Mechanical Engineers and Designers

BECHTEL

Offers you immediate long range engineering opportunity in

Los Angeles
New York
or
San Francisco

Engineers and designers with Steam Electric Generating Station, Refinery, or Process Plant experience will qualify. Mechanical engineers with related experience will be given thorough consideration.

Instrument Application Engineers

Mechanical engineers with instrument application experience on Steam Electric Generating Stations, Refinery, or Process Plants. Related experience acceptable.

Liberal relocation allowances for you and your family.

Send resume to
Manager of Employment & Placement
Industrial Relations Division

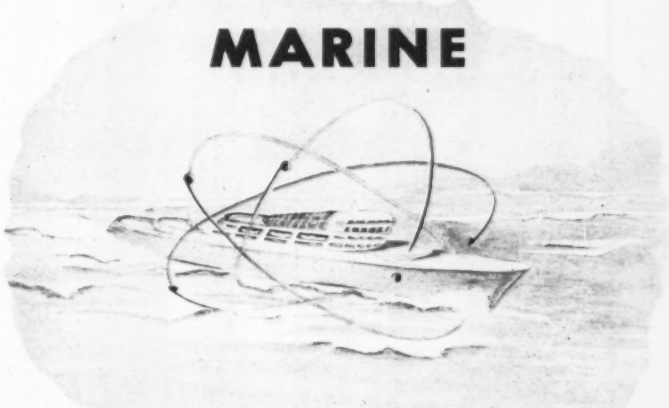
BECHTEL
CORPORATION
220 Bush Street
San Francisco 4, Calif.

For an immediate personal interview you may phone:
Paul Keating Plaza 7-4400, New York City
Joe Braddick, Fairfax 3-2401, Houston, Texas
Bill Milligan, Tucker 1549, Los Angeles, Calif.
Don Palmer, Douglas 2-4032, San Francisco, Calif.

Use a CLASSIFIED ADVERTISEMENT
For Quick Results

ENGINEERS

MECHANICAL
NUCLEAR
MARINE



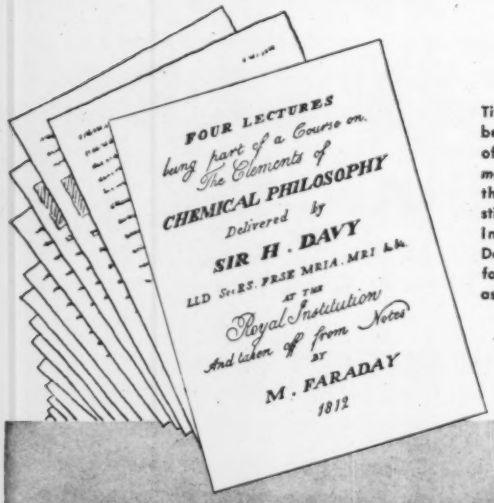
The **CENTRAL TECHNICAL DEPARTMENT** of Bethlehem's Shipbuilding Division, an experienced organization recognized for its technical achievements, offers unusual opportunities to recent college graduates to participate in the latest developments in naval and merchant ship design, including the application of nuclear power.

If you would like to make full use of your professional training in creative engineering, enjoy easy commuting and have convenient access to New England's educational and recreational facilities, you are cordially invited to write to us. Your inquiry will be considered confidential and acknowledged promptly.

BETHLEHEM STEEL COMPANY

Shipbuilding Division

PLEASE ADDRESS
C. H. GOLDTHWAITE,
ASSISTANT TO TECHNICAL MANAGER
CENTRAL TECHNICAL DEPARTMENT
QUINCY 69, MASSACHUSETTS



Title page of Faraday's beautifully illustrated set of notes that filled 386 *manuscript pages.* He sent the notes (which may still be seen in the Royal Institution Library) to Davy with a letter asking for a job as a laboratory assistant. (He got the job.)

The application letter that ELECTRIFIED THE WORLD!

A set of tickets given young Michael Faraday, book binder's apprentice, not only admitted him to a series of lectures by Davy but opened the door to the Age of Electricity through his discoveries of the principles of the dynamo and the electric motor.

To men like Faraday who would like to associate themselves with eminent scientists, physicists and engineers, Farnsworth's doors are wide open. The genius that created electronic television continues to lead advances in radar; counter-measures; missile guidance; control, and test systems; industrial electronics; special purpose tubes; infra-red systems; solid state physics; electronic research, and production . . .

ENOUGH HERE TO CHALLENGE A HUNDRED FARADAYS

Your resume (it needn't be 386 pages) will receive prompt, confidential attention.

Address Technical Employment Director
FARNSWORTH ELECTRONICS COMPANY, FORT WAYNE, INDIANA
A Division of International Telephone and Telegraph Corporation

MECHANICAL ENGINEER

To handle laboratory and technical service assignments on fuels. Opportunity in Major Oil Company for man with 3 to 5 years' direct or related experience with engine or burner fuels. Metropolitan New York.

Address CA-5870, % "Mechanical Engineering."

MECHANICAL DRAFTSMAN

Mechanical Draftsman experienced in power plant piping. Wonderful opportunity. Comprehensive fringe benefits. Write stating education, experience and salary desired. Duke Power Company; Employment Office; P.O. Box 2178, Charlotte, N. C.

MECHANICAL ENGINEERS

Engineering graduates for product design and application. Products are vibration and shock isolation systems on aircraft, electronic, automotive, marine, general industrial equipment. This is a rapidly expanding industry. Excellent long range possibilities for engineers who are interested primarily in design work. Duties also involve extensive liaison between and among field engineering, manufacturing, and research.

BOX 369, ERIE, PENNSYLVANIA

AREA ENGINEERS

Several graduate engineers with minimum 5 years' experience supervising maintenance engineering functions in oil refining or producing facilities, power plants, heavy industrial installations, manufacturing plants or related operations. To establish technical supervision, procedures, maintenance operations, and schedule routine and special work for major oil producing and refining operation with all supporting facilities; i.e., housing, feeding, recreation, etc.

Salary commensurate with background and experience. Write giving full particulars regarding personal history and work experience. Please include telephone number.

Recruiting Supervisor, Box 66

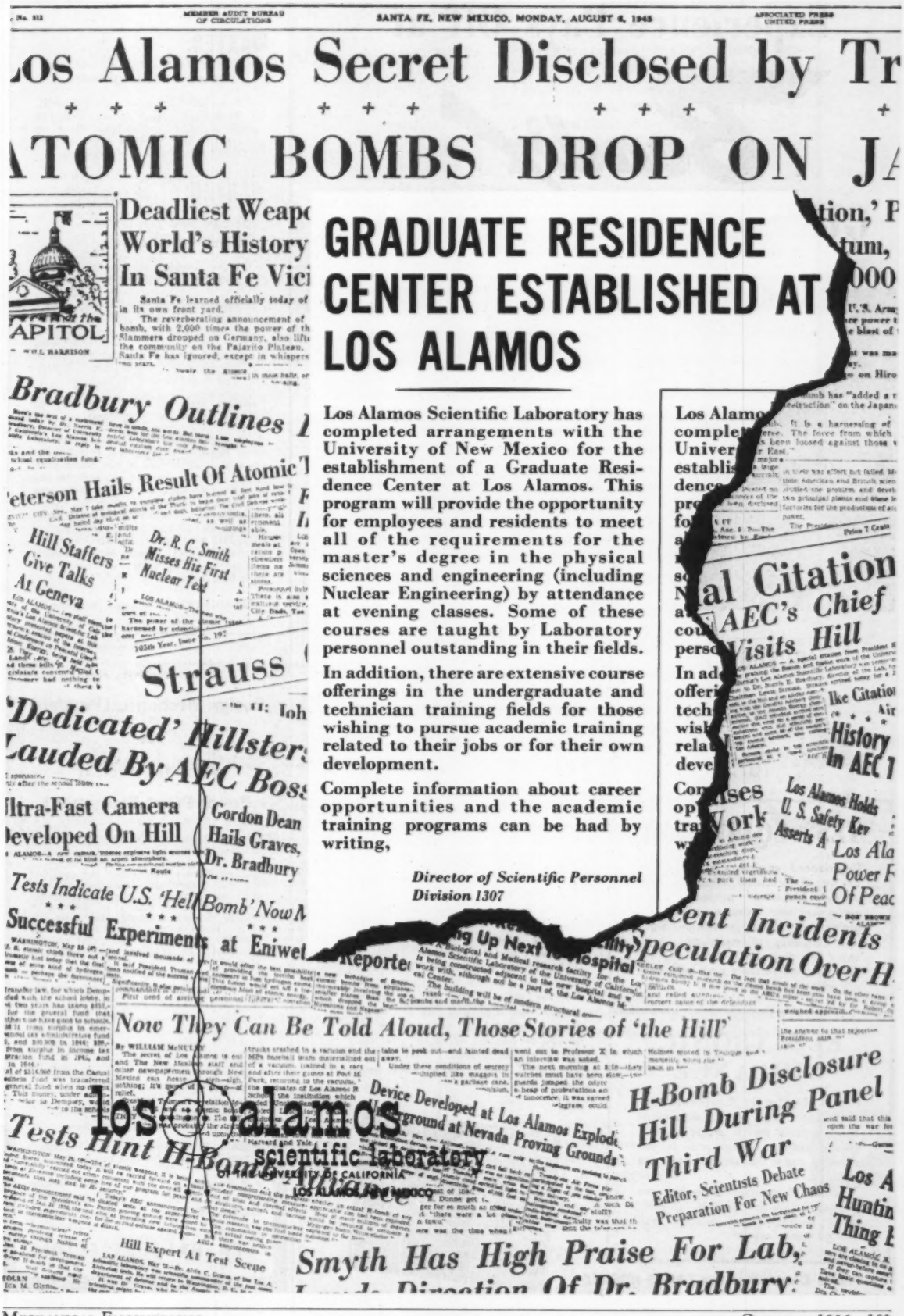
ARABIAN AMERICAN OIL COMPANY

505 PARK AVENUE
NEW YORK 22, N. Y.

PROJECT ENGINEERS

Challenging and interesting positions are open in Worthington Corporation for qualified mechanical engineers who seek opportunities as project leaders in product research and development. This is a chance to attain personal growth and profession standing with a growing organization that serves the air conditioning, petro-chemical, refinery and public utility fields. Work will be with such equipment as centrifugal pumps, compressors and various types of power plant equipment. Location is in northern New Jersey. Salaries commensurate with experience. Liberal benefits, including educational refund plan. Write for interview, enclosing a resume of your background, to

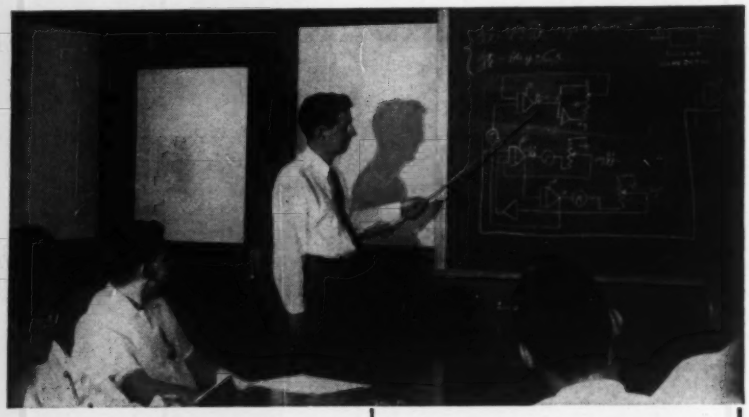
Personnel Department, Harrison Division
WORTHINGTON CORPORATION
Harrison, New Jersey


os Alamos Secret Disclosed by Tr
TOMIC BOMBS DROP ON J
Deadliest Weapo
World's History
In Santa Fe Vici
GRADUATE RESIDENCE CENTER ESTABLISHED AT LOS ALAMOS
Los Alamos Scientific Laboratory has completed arrangements with the University of New Mexico for the establishment of a Graduate Residence Center at Los Alamos. This program will provide the opportunity for employees and residents to meet all of the requirements for the master's degree in the physical sciences and engineering (including Nuclear Engineering) by attendance at evening classes. Some of these courses are taught by Laboratory personnel outstanding in their fields.
In addition, there are extensive course offerings in the undergraduate and technician training fields for those wishing to pursue academic training related to their jobs or for their own development.
Complete information about career opportunities and the academic training programs can be had by writing,
Director of Scientific Personnel
Division 1307
Bradbury Outlines
Hill Staffers Give Talks At Geneva
Dr. R. C. Smith Misses His First Nuclear Test
Strauss
'Dedicated' Hillster
Lauded By AEC Boss
Ultra-Fast Camera Developed On Hill
Gordon Dean Hails Graves, Dr. Bradbury
Tests Indicate U.S. 'Hell Bomb' Now A
Successful Experiments at Eniwet
Now They Can Be Told Aloud, Those Stories of 'the Hill'
Tests Hint H-Bom
Hill Expert At Test Scene
Device Developed at Los Alamos Explod
Ground at Nevada Proving Grounds
H-Bomb Disclosure
Hill During Panel
Third War
Editor, Scientists Debate Preparation For New Chaos
Smyth Has High Praise For Lab,
Direction Of Dr. Bradbury
al Citation
AEC's Chief Visits Hill
Ike Citation
History In AEC
Los Alamos Holds U. S. Safety Key Asserts A
Los Ala Power F Of Peac
cent Incidents
Speculation Over H
los alamos
scientific laboratory
OF THE UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO

Experience Pays Off at

Bendix

GUIDED MISSILE SECTION



Unusual Job Opportunities for:

TEST EQUIPMENT

Experienced engineers required for design of precision electronic and electro-mechanical automatic test equipment and instrumentation. Programming, signal generation from low frequency to microwave, analogue and digital data handling, and go-no-go comparators and indicators are involved.

ELECTRONIC GUIDANCE

Senior Electronic Engineers are needed to design and develop guidance systems for a major guided missile project. Backgrounds in microwave, radar and servo systems are required.

Senior Mechanical Engineers are needed to design and develop electronic packaging for complex missile guidance systems.

SYSTEMS ANALYSIS

Senior Engineers are needed with extensive backgrounds in the over-all dynamic behavior of missiles and weapons systems, as well as airframe systems of a missile, particularly in terms of weapon performance, to work with analogue computers, digital differential analyzers, breadboards, prototypes of missiles and missile equipment, and special mechanical and electronic simulators. Experience with aerodynamics, servo-mechanisms, electronics, heat transfer, stress analysis, shock and vibrations is desirable.

Bendix Guided Missiles offer interesting job opportunities for Senior Engineers, Assistant Engineers, Junior Engineers and Technicians.

A thirty-six page book, "Your Future in Guided Missiles", describing in detail the many phases of our guided missile operation and the job opportunities available to you, will be sent to you on request. Write for your copy today. BENDIX PRODUCTS DIVISION—MISSILES, 409F, Bendix Drive, South Bend, Indiana.

Prime Contractor for TALOS MISSILE

WANTED:

Development Engineers

For new product development. Must have 5 years' or more design or development experience. Must be creative and able to work without direct supervision. Salary open.

WANTED:

Stress and Vibration Analyst

Work involves static and dynamic analysis of miniature devices. Present unique opportunity for important individual contribution. Work represents beginning of a trend from the empirical to the analytical and can mean a great deal to right man. Must have M.S. minimum in applied mechanics, or similar field. Experience desirable but not essential.

Positions also available for applied physicist and electrical engineers.

A growing Midwestern manufacturer of small electrical devices and switches has unusual opportunities in the above positions. This 20 year old organization has long been a leading supplier to every type of industry. Work is challenging with a high degree of engineering independence. Plant is located in a pleasant community of 25,000 which provides excellent recreational facilities. Please send complete resume including salary expected. Replies held confidential.

Address CA-5902, % "Mechanical Engineering."

Engineer, ME, AE

Design Mechanical Portions of Aircraft Nuclear Power Plant Equipment

General Electric now offers the qualified engineer a rare opportunity to combine good judgment, sound engineering fundamentals and the ability to work with others. This is a career position in one of the latest aeronautical areas, aircraft nuclear propulsion. The working environment is excellent... the personal benefits, comprehensive.

The engineer who qualifies for this job will be responsible for the design and proper functioning of the mechanical portions of power plant equipment associated with both engines and reactors. This means he must have 3 to 8 years' experience in the mechanical design of lightweight, high temperature machinery, preferably experience in turbojet engines. An advanced degree is desirable.

Openings in Cincinnati, Ohio and Idaho Falls, Idaho

Address replies in confidence, stating salary requirements, to location you prefer...

J. R. Rosselot
P. O. Box 132
Cincinnati, Ohio

L. A. Munther
P. O. Box 535
Idaho Falls, Idaho

GENERAL ELECTRIC

ENGINEERS

ELECTRIC BOAT STEPS-UP NUCLEAR SUBMARINE PROGRAM

offers unusual growth opportunities to engineers

Two years ago, world attention centered on Electric Boat at Groton, Connecticut where scientific boldness harnessed the power of atomic energy to launch the Nautilus, which will soon be followed by its sister ship, Seawolf. Next to glide down the ways will be even more powerful versions . . . a third, fourth and fifth nuclear powered craft.

Now, engineers who are cognizant of the implications of the Atomic Age are concentrating their interest on Electric Boat. The following opportunities exist for:

a) **Naval Architects**

b) **Mechanical and Electrical Engineers** with 3 to 5 years experience in the application of mechanical and electrical marine power plant equipment.

c) **Electrical and/or Mechanical Engineers** for basic design using analog computers, with respect to control systems, motor control circuits, power plant, speed and voltage regulators or fluid flow and thermodynamics. Familiarity with engine room and reactor plant electrical systems and controls desirable.

At Electric Boat your professional success is spurred by company sponsored courses at the plant, advanced study at leading universities, and by attention to broader professional growth by immediate supervision.

Electric Boat's location in Groton on the lovely shore of Long Island Sound makes life as pleasant as your job is stimulating. The surrounding resort area is well known for its year-round sports and recreational activities. And, you have all the advantages of nearby New York and Boston as well.

Interviews can be arranged by sending resumes to Peter Carpenter.

ELECTRIC BOAT
Division of General Dynamics Corporation
GROTON • CONNECTICUT

Metallurgical *Mechanical*

Material and Process Engineer

This is your chance to gain the exceptional professional and personal advantages enjoyed by engineers at this renowned Jet & Rocket Engine Center.

You need a BS degree in Metallurgical and Mechanical Engineering, 2 years' experience in metallurgical work on materials and processes application or failure analysis in a laboratory, and 2 years' work in high temperature metallurgy in a laboratory or on material application problems.

You will be responsible for: development, evaluation, application, control and improvement of materials & processes for advanced aircraft engines; providing counsel on design and manufacture; liaison with subcontractors and in development of new materials and manufacturing processes; product improvement and cost reduction programs—where careers go further and faster: in Flight Propulsion—at this major company.

Send resume in confidence to:

BOX CA-5916

care of "Mechanical Engineering."

SENIOR MECHANICAL ENGINEERS

Pacific Semiconductors has openings for Senior Mechanical Engineers for the design and development of automatic and semi-automatic machinery and equipment for manufacturing semiconductor devices including diodes and transistors of advanced design. B.S. or M.S. degree in mechanical engineering, five or more years experience, and ability to carry project responsibility is required. Salary will be commensurate with ability, training and development potential of the applicant.

Send resume or write:
MR. J. C. ROSS,
Industrial Relations Mgr.

PACIFIC SEMICONDUCTORS, INC.
10451 W. Jefferson Blvd., Culver City, California

mechanical engineers

Texas Instruments expanding research, development, and manufacturing programs have opened outstanding opportunities for mechanical engineers. TI offers you real chances for advancement in a rapidly-growing industry. Positions are now available in the following fields of engineering:

AEW and ASW radar
Sonar
MAD equipment
Missile telemetering systems
Intervalometer design
Transistor circuit applications
Microwave component development
Infrared radiation development
Electrical meter design
Production planning and control

At Texas Instruments, you will have the long range stability of a 25-year-old firm with many notable "firsts" in the fields of semiconductors, geophysics, radar, infrared radiation, and others. You will enjoy the many living, cultural, and recreational rewards of the sunny Southwest. We would be glad to discuss these career opportunities with you . . . our profit-sharing plan and other personnel advantages at Texas Instruments.

Address brief résumé to:
Mr. Dale O. Simpson

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

AN OPPORTUNITY AT WORTHINGTON

Interesting positions open at Worthington's northern New Jersey centrifugal pump Sales headquarters. Work includes pump selection, product development, assisting field engineers for such industries as power generation, process, marine, public works, etc. Salary commensurate with ability, experience, and education, with excellent opportunities for advancement. Liberal benefits with insurance, pension, and education tuition plans. Reply giving personal data, employment record, and previous experience.

Personnel Department S, Harrison Division

WORTHINGTON, CORPORATION
Harrison, New Jersey

EVER CONSIDER

Engineering Journalism

AS A CAREER?

More and more engineers are joining the ranks of industrial magazine editors, realizing that by education and training they have a bedrock foundation for a successful career in engineering journalism.

There are many industrial magazines whose editors must be engineers for it is to engineers that the editorial content is directed. It is a basic law of good editing that editors must talk the language of readers. Engineering knowledge and experience constitute the common denominator—the bridge in communication between readers and editors of engineering publications.

With its many contacts of industry authorities and exposure to exciting engineering developments, the function of editing broadens one's horizons and opens up new fields for exploration for men who are eager to make the most of opportunity.

Truly, engineering journalism of today offers its professional as well as material rewards to those who recognize in their engineering base a foundation for a writing career.

If you are an engineering graduate with experience in design engineering of products, a designer, laboratory or application engineer, and believe you know how to write or have confidence you can learn, the Editor of this long established technical publication (New York headquarters) invites you to contact him for particulars.

Address CA-5947, % "Mechanical Engineering."

MAINTENANCE ENGINEERS

Immediate openings for Planning and Scheduling and Area Maintenance engineers are available in the Maintenance Section of our Petrochemical Plant located on the southern Texas gulf coast. For these openings we would prefer applicants with related experience backgrounds; however, experienced mechanical engineers will also be considered. In addition, openings are available for which applicants with other types of engineering backgrounds will be considered. These openings are at junior, intermediate and advanced employment levels in applicable engineering work.

Positions offer stable employment, advancement opportunity with newly established and growing organization, and a liberal, well balanced group of employee benefit plans. Salaries will be commensurate with training and work experience.

Forward complete employment resumé together with a recent photograph, details concerning age, marital status, educational background and salary requirements. All replies confidential.

Stanolind Oil and Gas Company
Employment Office
P. O. Box 1712
Brownsville, Texas

MACHINE DESIGNERS
M.E. GRADUATE
OR
EQUIVALENT

Experienced in the design of crawlers and rubber mounted cranes and shovels. Knowledge of heavy duty truck design would be valuable.

Excellent opportunity for permanent position with well established mid-west firm now expanding on west coast.

Salary commensurate with ability—All replies confidential.

Send resume of experience to:

THE INSLEY MANUFACTURING CORP.

Attention — Chief Engineer
801 N. Olney St.
Indianapolis, Ind.

ESSO ENGINEERING IS EXPANDING
MECHANICAL ENGINEERS NEEDED

Career openings available in long range expansion program. Work involves surveys, investigations, preliminary design specifications (no drafting), trouble shooting, and occasional field follow-up.

Prefer men of high scholastic rating and with one to seven years' experience. There are also a number of openings for very recent graduates. Both Bachelors and Masters degree positions are available. Salary commensurate with experience and qualifications.

If you are interested in an opportunity for growth and promotion with a leader in the petroleum industry, write today giving full details of education, experience, salary desired, availability date and references.

All inquiries will be considered promptly and held confidential.

ESSO RESEARCH AND ENGINEERING COMPANY
Esso Research Center
Employee Relations-C
P.O. Box 51 **Linden, N. J.**

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC.

(Agency)

New York	Chicago	Detroit	San Francisco
8 West 40th St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

This placement service is sponsored by the Four Founder Societies for its members. Why not make use of it? It is operated as a non-profit organization. Applicants, if placed through the Service, agree to pay a fee at the rates listed by the Service. All replies should be addressed to the key numbers indicated and mailed to the New York office. Please enclose six cents in postage to cover cost of mailing and return of application.

Two weekly bulletins of engineering positions open, one covering positions on the Pacific Coast and the other covering Mid-western and East Coast positions, are published and each is available to members at a subscription rate. The Service also publishes a Men Available Bulletin semi-monthly. This bulletin is sent to employers throughout the United States. You are invited to submit your notice for publication.

Bendix needs ELECTRONIC and MECHANICAL ENGINEERS

FOR AIRBORNE RADAR AND SONAR SYSTEMS

in SOUTHERN CALIFORNIA

Unusual engineering positions in electrical and mechanical design of Telemetering Systems are available. These positions, which are directly associated with our long-range projects for industry and for defense, are available at all levels.

There also are important positions open for Electronic Test Equipment Designers, Circuit Designers and Microwave and Transistor Engineers.

You are invited to consider becoming a member of this vital engineering group — with a forward looking company in Southern California.

Please fill in the coupon or write us for complete information.

W. C. Walker, Engineering Employment Manager
Pacific Division, Bendix Aviation Corp.
11604 Sherman Way, North Hollywood, Calif.

I am interested in Telemetering Engineering.

I am a graduate engineer with_____degree.

I am not a graduate engineer but have_____ years experience.

Name_____

Address_____

City_____ Zone____ State_____

MECHANICAL ENGINEER

A large Midwest laboratory offers an excellent opportunity for a person with qualifying experience to work on hydrocarbon gas production processes. Work involves evaluating existing processes and developing improved processes for reforming hydrocarbon feed stocks into gases for chemical manufacture and industrial use. Attractive ideas will be developed by pilot plant operations. Applicants with training and experience in above areas are desired but initiative and ability are of most importance. Send details of experience, education and salary requirements. Replies will be given prompt consideration and will be held in complete confidence.

Address CA-5943, % "Mechanical Engineering."

Research and Development Engineers

Electrical and mechanical, interested in work involving design of equipment of a specialized nature, instrumentation research, and development of specialized test procedures. Should be capable of generating ideas and following them through the design and experimental stages. Position offers diversity of activities and excellent opportunities for creative work. Please send complete resume of education and experience to

Southern Research Institute
917 South 20th Street
Birmingham 5, Alabama

RESEARCH ENGINEER

B.S. in Engineering Mechanical or Metallurgical preferred

Better than average scholastic record required. Recent grad or up to 3 years' experience. Welding experience not essential. Research work largely in field of gas-shielded arc welding. Must be capable of conducting investigations with a minimum of supervision and of writing clear reports for research management.

This is a permanent position offering good salary & opportunity for personal & professional growth. Liberal benefits include well-established pension, group insurance & stock investment plans.

For Appointment Phone, Apply or Write Personnel Manager

AIR REDUCTION RESEARCH LABS

Murray Hill **New Jersey**

CRestview 3-6700

CHEMICAL OR MECHANICAL ENGINEER—desired with initiative, resourcefulness and mechanical ability who can accept project assignment and carry it through to successful completion Position includes some equipment maintenance as well as design or selection, layout and installation of chemical and process equipment. Engineering degree and several years of experience required. An excellent opportunity for a mature young man in a long established midwestern company. Send resume of background and experience together with minimum requirement. Address CA-5929, care of "Mechanical Engineering."

MECHANICAL ENGINEERS—to work on exploratory design and development of company products. Broad interests required covering analytical, experimental and/or design approaches. Need several engineers with 2 to 7 years' experience for new laboratory in Chicago suburb. Send resume to: Technical Personnel Director, Research Center, Borg-Warner Corp., Des Plaines, Ill.

LUBRICATION RESEARCH ASSISTANTSHIPS for graduate study with part-time employment assisting research group investigating oil film "whip" etc. in high-speed plain bearings. Start Feb. or Sept. Write Prof. G. Dubois, Mech. Eng'g, Cornell Univ., Ithaca, N. Y.

METALS RESEARCH LABORATORIES REQUIRIES SUPERVISORY DESIGN ENGINEER

MECHANICAL ENGINEER: To supervise activities of close-knit Engineering Design Group of a metallurgical and process research laboratory. Responsible for lay-out and design of metallurgical, metallurgical-chemical and chemical equipment, and small pilot plants as well as design work on an extensive variety of other projects. Advanced degree desirable and 3 to 5 years' experience in related work required. Send resume of education, experience and desired salary to:

J. L. Lamont, Personnel Administrator
METALS RESEARCH LABORATORIES
ELECTRO METALLURGICAL COMPANY
P. O. Box 580 **Niagara Falls, New York**

HEATING & VENTILATING ENGINEER PIPING DESIGN ENGINEER

Permanent positions for graduate engineers with experience are available in a large diversified pulp and paper manufacturing plant in the Upper Midwest. Our employees know of these openings. Reply giving personal, educational, and work history together with salary thinking. Your reply will be kept strictly confidential.

Address CA-5819, % "Mechanical Engineering."

MECHANICAL ENGINEERING PETROLEUM ENGINEERING or ENGINEERING MECHANICS GRADUATES

Excellent opportunities in Engineering Research, Theoretical Development and Mathematical Analysis work in a recently organized branch of fast growing major oil company. Challenging problems in the fields of Fluid Mechanics, Heat and Mass Transfer, Thermodynamics and Applied Mechanics. Opportunity to work closely with electronic computing group. Pleasant southwest community.

PERSONNEL PROCUREMENT
RESEARCH AND DEVELOPMENT DEPARTMENT

PHILLIPS PETROLEUM COMPANY

Bartlesville, Oklahoma

MECHANICAL AND STRUCTURAL DESIGN ENGINEERS and DRAFTSMAN for plant layout work and automatic equipment. Work involves board work and some field word. Experience in pulp or paper mill helpful but not essential. Location Mississippi. Good opportunity for desirable applicants. Give experience and salary range with application. Address CA-5879, care of "Mechanical Engineering."

FACULTY APPOINTMENT OPEN in the field of Dynamics or elasticity, with opportunities for consulting and research work. Rank and salary depend on qualifications. Department of Mechanical Engineering, Polytechnic Institute of Brooklyn, Brooklyn 1, N. Y.

ELECTRICAL ENGINEERING DRAFTSMAN for general plant power layout work also automatic control. Give experience and present salary range with application. Location Mississippi. Address CA-5878, care of "Mechanical Engineering."

MECHANICAL DEVELOPMENT ENGINEER—to assist in developing specialized manufacturing equipment not otherwise available. Will also lead a group investigating possible applications of the principles of automation to manufacturing and packaging operations. Applicant should have a good imagination and a good background in practical machine shop practice together with an engineering degree and a genuine interest in devising and experimenting with mechanisms and machines. The opportunity to organize and lead a small department devoted to this endeavor awaits the man who qualifies. Permanent position with internationally known midwest firm. Resume required. Address CA-5928, care of "Mechanical Engineering."

POSITIONS WANTED

LICENSED ENGINEER—M.E. and E.E. 25 years' experience maint. eng. and constr. mining smelting and chem. plant. Age 47. Languages. Desires position change. Address CA-5939, care of "Mechanical Engineering."

MECHANICAL ENGINEER—BME '55, 1½ years' experience, fluent German and Russian, interested in position where both technical and linguistic background can be fully utilized. Will consider overseas assignment. Address CA-5922, care of "Mechanical Engineering."

SALES-APPLICATION ENGINEERING position desired. Age 26, BS General Engineering 1952, Married, previous experience with construction equipment, pumps, air compressors, turbines, engines, vacuum equipment, and controls. Relocate anywhere in U. S. Address CA-5930, care of "Mechanical Engineering."

GRADUATE ENGINEER—12 years' experience desires position plant maintenance supervision utility or industrial firm. Heavy experience multi-craft supervision in power plant installation, inspection, repair, operation, and personnel training. Address CA-5931, care of "Mechanical Engineering."

EMPLOYMENT AGENCIES AND SERVICE BUREAUS

PLANT PERSONNEL, ENGINEERS, DESIGNERS—Draftsmen, Chemists, and Metallurgists, E. G. Strout, Member ASME and President of Cleveland Engineering Agency Co., 2132 E. 9th St., Cleveland 15, Ohio, will help you find positions or men.

SALARIED POSITIONS—$6,000 to $35,000. We offer the original personal employment service (established 46 years). Procedure of high standards individualized to your personal requirements. Identity covered. Particulars—R. W. Bixby, Inc., 562 Brisbane Bldg., Buffalo 3, N. Y.

SALARIED PERSONNEL $5,000 to $30,000

This nation-wide service, established 1927, is geared to the needs of high grade men who seek a change of connection under conditions, assuring if employed full protection to present position. Send name and address only for details. Personal consultation invited.

JIRA THAYER JENNINGS
Dept. J, P. O. Box 674 Manchester, Vermont

REPRESENTATION WANTED

MANUFACTURER of Heat Exchangers and Pressure Vessels, located in New Jersey, wants sales representatives in various parts of country. Representative should have contacts in oil refineries, power plants, chemical plants or marine. Address CA-5752, care of "Mechanical Engineering."

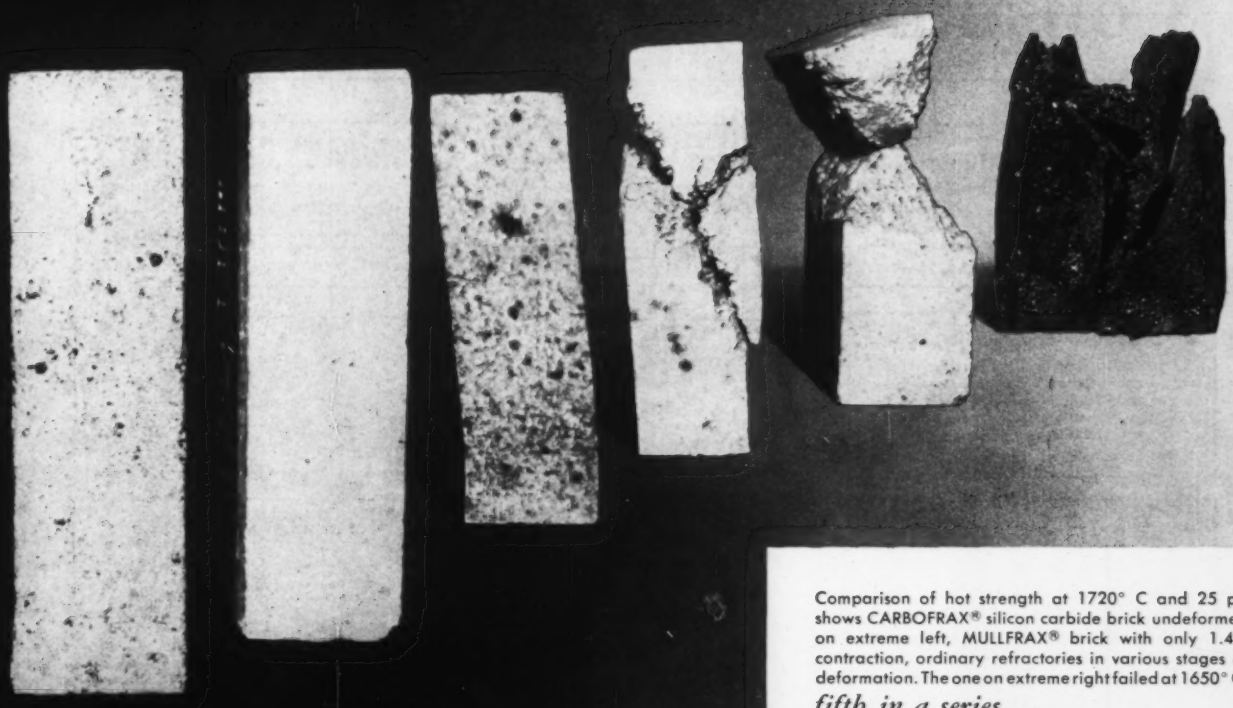
SERVICES AVAILABLE

GRADUATE MECHANICAL ENGINEER—seeks professional advancement as to design, development and research in turbomachinery, fuel atomization, industrial combustion, etc. (patent applications pending). Address CA-5926, care of "Mechanical Engineering."

BUSINESS OPPORTUNITIES

EUROPEAN MANUFACTURER of exceptionally efficient high pressure packaged steam generators, from 15 to 500 HP, offers U.S. license. Can supply highly developed technical assistance. Write Leon G. Rucquoi, Technical and Economic Consultant, 30 Rockefeller Plaza, New York 20, N. Y.

Use a CLASSIFIED ADVERTISEMENT *for Quick Results*



Comparison of hot strength at 1720° C and 25 psi shows CARBOFRAX® silicon carbide brick undeformed on extreme left, MULLFRAX® brick with only 1.4% contraction, ordinary refractories in various stages of deformation. The one on extreme right failed at 1650° C.

fifth in a series . . .

HOT STRENGTH

Unusual Properties of Refractory Materials

Hot Strength—When load is applied to a refractory its ability to resist heat is lessened. Increasing either load or temperature, or both, often causes the refractory to fail.

As these factors are combined in most installations — large and small — hot strength of a refractory takes on new value.

The effect of temperature in combination with load is shown by specimens pictured above. Further tests provided these data: In a test under 50 psi, a MULLFRAX® electric furnace mullite brick showed no linear contraction when held at 1500°C for 100 hours. Ordinary brick contracted an average of 7.58% at 1500°C but that at only 35 psi. In another typical case complete failure (15% contraction) was experienced with a commonly-used refractory at 1350°C and a load of 25 psi.

These differences in hot strength prove this: Where refractories fail under load and temperature, Carborundum refractories have the *extra* resistance needed to avoid slumping and, thereby, to effect less downtime, lowered maintenance costs and greater output.

Hot strength may work in another way, too. It permits use of thinner section refractories, thus reducing overall load. More insulation may be used to lower heat losses.

Carborundum's magazine "Refractories" pinpoints many practical applications for these unusual products. The next issue carries a feature article on "hot strength". Send for your copy today.

CARBORUNDUM

Registered Trade Mark

VALUABLE INFORMATION FOR USERS OF:

REFRACTORIES • CASTABLE CEMENTS • POROUS PLATES AND TUBES

CATALYST SUPPORTS • OXIDE, BORIDE, NITRIDE AND CARBIDE

HIGH-TEMPERATURE MATERIALS • CERAMIC FIBER

all in the new magazine "Refractories"

MAIL THIS COUPON TODAY

Dept. 1106, Refractories Division
The Carborundum Company, Perth Amboy, N. J.

Please send me the forthcoming issue of "Refractories".

Name_____ Title_____

Company_____

Street_____

City_____ Zone_____ State_____

Consulting Service

Manufacturers of equipment not included

RATES: One-inch card announcements inserted at rate of $20 each issue, $15 per issue on yearly contract

BLACK & VEATCH
CONSULTING ENGINEERS
Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction
Investigations, Valuation and Rates
4706 Broadway Kansas City 2, Missouri

The Kuljian Corporation
ENGINEERS • CONSTRUCTORS • CONSULTANTS
POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)
UTILITY • INDUSTRIAL • CHEMICAL
1200 N. Broad St., Phila. 21, Pa.

PROPANE GAS PLANTS
and
Anhydrous Ammonia Plants
PEACOCK CORPORATION
Box 268, Westfield, N. J. Westfield, 2-6258

Electrical Testing Laboratories, Inc.
Electrical, mechanical, photometric, radiometric and chemical laboratories, rendering testing, research and associated services, including certification, inspections at factories and field investigations
2 East End Avenue at 79th St., New York 21

PETER F. LOFTUS CORPORATION
PFLC ESTABLISHED 1923
Design and Consulting Engineers
Electrical • Mechanical
Structural • Civil
Thermodynamic • Architectural
FIRST NATIONAL BANK BUILDING
Pittsburgh 22, Pennsylvania

Consult **Z. H. POLACHEK**
Reg. Patent Attorney
1234 Broadway
(at 31St.) New York 1, N. Y.
Phone LO-5-3088

DRAFTING SERVICE
DESIGNING AND DETAILING
FOR INDUSTRY
434 MAIN STREET
MT. PLEASANT, PA. KIMBALL 7-2033

THE LUMMUS COMPANY
ENGINEERS AND CONSTRUCTORS
385 Madison Avenue, New York, N. Y.
Chicago -- Houston -- London -- Paris
The Hague -- Montreal -- Caracas -- Bombay

SANDERSON & PORTER
CONSTRUCTION
REPORTS SURVEYS
New York New York

GAI
GILBERT ASSOCIATES, INC.
Engineers and Consultants
Design and Supervision of Construction
Mechanical • Electrical • Structural
Sanitary • Chemical Laboratory
Business and Economic Research
New York **READING, PA.** Washington

research and development
product engineering and styling
special production machines
model building
write for brochure
MAST DEVELOPMENT CO. INC
2212 E 12th St. - DAVENPORT, IOWA

Power Plants, Structures
Transmission Systems
Design, Supervision, Inspection
Appraisals, Reports
SARGENT & LUNDY
140 S. Dearborn St., Chicago, Ill.

HARZA ENGINEERING COMPANY
CONSULTING ENGINEERS
E. Montford Fucik Calvin V. Davis
Richard D. Harza
Hydroelectric Plants and Dams
Transmission Lines
Flood Control Irrigation
River Basin Development
400 West Madison Street Chicago 6

WELD TESTING
Qualification of Operators—Supervision
Inspection—Research
NATIONAL WELD TESTING BUREAU
Pittsburgh Testing Laboratory, Pittsburgh, Pa.

J. E. SIRRINE COMPANY
Engineers
Design and Supervision of Steam and Hydro-Electric Power Plants. Industrial Plant, Mechanical and Operating Surveys, Appraisals • Plans • Reports
Greenville, South Carolina

JACKSON & MORELAND, INC.
Engineers and Consultants
Design and Supervision of Construction
Reports—Examinations—Appraisals
Machine Design—Technical Publications
BOSTON NEW YORK

PANELLIT SERVICE CORP.
Instrumentation Systems
ENGINEERS & CONSTRUCTORS
7401 M. HAMLIN AVE. SKOKIE, ILL.
TEL: ORCHARD 5-2500
Los Angeles, Calif. • Wilmington, Delaware
Toronto, Canada

Foster D. Snell, Inc.
29 W. 15th St., N. Y. 11, N. Y.
CONSULTING CHEMISTS & ENGINEERS
Research, Development, Formulation, Testing, Evaluation, General Investigations.
Lubricants, Hydraulic Fluids, Bearing and Friction Surfaces, Metal Cleaning and Corrosion Prevention.
Write for Paper on Lubricant Additives.

M. W. KELLOGG
Piping System Design Analyses
Unique model tester as well as modern digital computer facilities available for low cost, accurate flexibility analyses of the most complex piping systems.
The M. W. Kellogg Company
711 Third Avenue, New York 17, N. Y.

An announcement in this

section will acquaint others

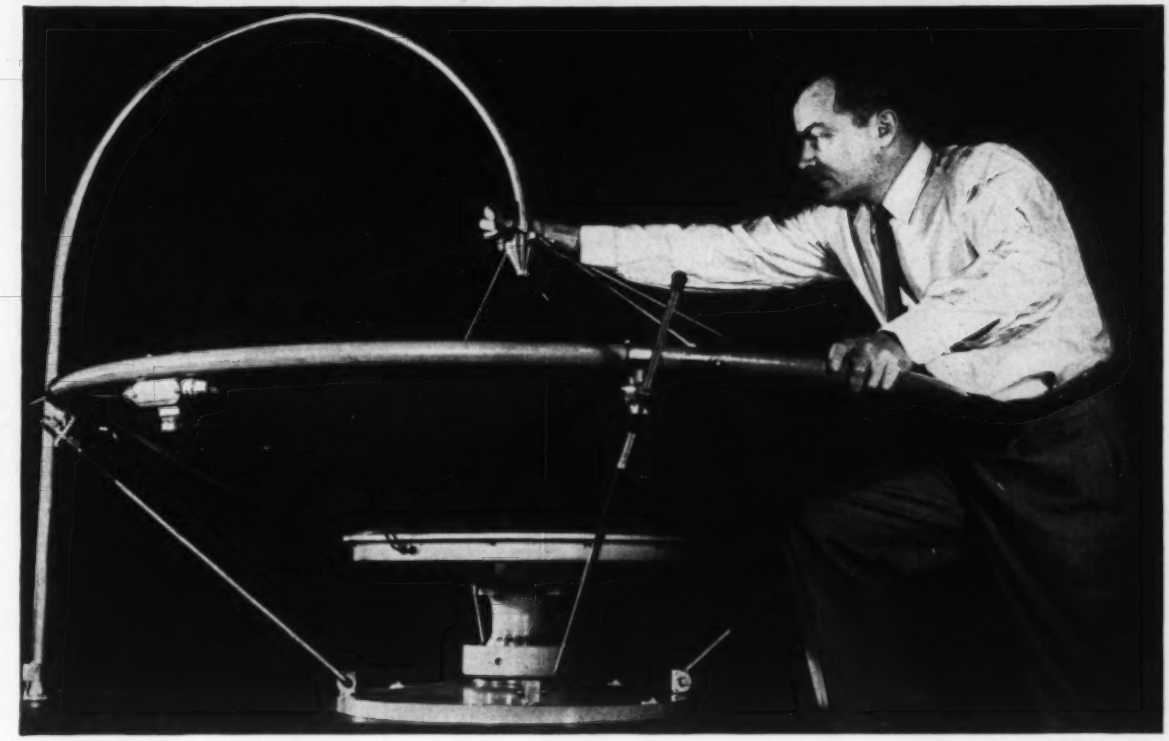
with your specialized practice.

STANLEY ENGINEERING COMPANY
CONSULTING ENGINEERS
208 S. LaSalle Street Hershey Building
Chicago 4, Illinois Muscatine, Iowa

GEORGE H. KENDALL
Consulting Mechanical Engineer
Methods Studies: Process of Product
Redesign Existing Products for Greater Profit
Trouble Shooting Production, Design, Cost Problems.
Specialist Automatic Machinery Processes, Controls, New Developments, Patent Studies, Investigations, New Products & Process Engineering Studies.
P. O. Box 3 (*Est. 1923*) Tel. Darien 5-1504
Noroton Heights 3 Offices Darien, Connecticut

ALDEN E. STILSON & ASSOCIATES
LIMITED
CONSULTING ENGINEERS
E. RALPH SIMS, JR.
Industrial Engineer
Manufacturing & Distribution Studies
245 North High Street Columbus, Ohio

TEACHING A GIANT TO TAKE SHORT STEPS



Bell Laboratories' Dr. J. W. Fitzwilliam adjusts a waveguide feed to a parabolic dish reflector. Dr. Fitzwilliam, who has a Ph.D. in physics from Massachusetts Institute of Technology, leads the practical development of Bell's new 11,000-mc. system. Components had to be developed to operate in a frequency band not previously utilized.

The giant microwave highway that carries your TV programs along with telephone conversations from coast to coast has a versatile new partner — an entirely new microwave system which was created, and is now being developed, at Bell Laboratories. The new system operates at 11,000 megacycles — a much higher frequency than ever before used in telephone service.

Bell's present microwave systems — operating at 4000 megacycles — were designed for heavy traffic and long distances. The new system is designed especially for lighter traffic and shorter distances—up to 200 miles. Its traffic capacity is extremely flexible. Depending on traffic needs, the system can provide only one one-way or as many as three two-way broadband channels. Each two-way channel can carry 200 telephone conversations simultaneously or one television program in color or black and white in each direction along a route. The new microwave system, which is already being operated experimentally, will be valuable in providing additional telephone service and television programs for cities in remote areas.

This is another example of how research and development work at Bell Telephone Laboratories help the Bell Telephone System to serve you better.

Mr. L. C. Tillotson, who originated the new system, adjusts the klystron-isolator combination which made the system feasible. Mr. Tillotson, an M.S. from the University of Missouri, is in charge of research in microwave applications.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

Index to Advertisers

AC Electronics Div., General Motors Corp. 76, 82, 90, 171
Acme Chain Corp. 45
Aerojet-General Corp. Sub. General Tire & Rubber Co. 50, 51
Aero Research Instrument Co. 161
*Air Preheater Corp. 131
Ajax Flexible Coupling Co. 66
*Allegheny Ludlum Steel Corp. 99
Allen-Bradley Co. 93, 94
*American Blower Corp. Div. American-Standard 10
*American Brass Co. 21
American Felt Co. 25
American Pencil Co. 162
ASME Publications 86, 136, 160
Mechanical Catalog 134
Amplex Div., Chrysler Corp. 27
Argonne National Laboratory 98
*Armstrong Machine Works 139
*Associated Spring Corp. 17
Aurora Pump Div., New York Air Brake Co. 78

*Babcock & Wilcox Co. 2nd Cover
*Bailey Meter Co. 146
Bechtel Corp. 179
Bell Telephone Laboratories 189
Bendix Aviation Corp. Pacific Div. 185
Utica Div. 165
Bendix Products Div.—Missiles 182
Bethlehem Steel Co. 179
*Bin-Dicator Co. 159
*Blaw Knox Co., Grating Dept. 65
Boeing Airplane Co. 140
Boston Gear Works 19
Braun, C. F. & Co. 172, 178
Bridgeport Thermostat Div. Robertshaw-Fulton Controls Co. 53
Bruning, Charles, Co. 118
Brush Electronics Co. 124
*Buffalo Forge Co. 28
Bundy Tubing Co. 135
Bunting Brass & Bronze Co. 61
*Byron Jackson Pumps (Inc.) 29

Caltech, Jet Propulsion Laboratory 130
Carborundum Co. 187
Chain Belt Co. 127, 128
Chance Vought Aircraft (Inc.) 167
Chemstrand Corp. 49
Cincinnati Gear Co. 86
Columbia-Geneva Steel Div., 14, 15, 109, 122
*Combustion Engineering (Inc.) 153
Cone-Drive Gears Div., Michigan Tool Co. 42
*Consolidated Chimney Co. 79
Convair Div. General Dynamics Corp. 62, 144
Copperweld Steel Co. 3
Crane Co. 24
Crane Packing Co. 59
Cunningham, M. E., Co. 92
Curtiss-Wright Corp. 154

Denison Engineering Div. American Brake Shoe Co. 2, 107
*Detroit Stoker Co. 133
DeZurik Shower Co. 163
Diamond Chain Co. (Inc.) 37
Douglas Aircraft Co. 138
Downey Missile Engineering Div. North American Aviation (Inc.) 89
Dravo Corp. Machy Div. 126
Tri-Lok 80
Dresser Industries (Inc.) Roots-Connersville Div. 67
Dudek & Bock Spring Mfg. Co. 92
DuMont, Allen B., Labs. (Inc.) 32
du Pont de Nemours, E. I. & Co. 169, 175

Eagle Pencil Co. 31
Eagle Signal Corp. 43
Eaton Mfg. Co. Dynamatic Div. 11
Edward Valves (Inc.) Sub. Rockwell Mfg. Co. 115
*Elastic Stop Nut Corp. of America 75
Electric Boat Div. General Dynamics Corp. 183
Erie City Iron Works 143
*Esso Research & Engineering Co. 185

Fafnir Bearing Co. 141
Farnsworth Electronics Co. 180
Firestone Guided Missile Div. 192
*Flexitallic Gasket Co. 39
*Flexonics Corp. 74
Formica Co. 105
*Foster Wheeler Corp. 8, 9
Frick Co. 81

*Garlock Packing Co. 73
Garrett Corp. 64
General Electric Co. 151, 170, 182
General Fireproofing Co. 145
General Radio Co. 20
*Golden-Anderson Valve Specialty Co. 68
Goodyear Atomic Corp. 169
Graphic Systems (Inc.) 77

Hamilton Standard Div. United Aircraft Corp. 162
Hays Mfg. Co. 88
*Homestead Valve Mfg. Co. 104
Horspool & Romine Mfg. Co. 80
Hughes Research & Development Labs. 102

International Nickel Co. 34

Jeffrey Mfg. Co. 117
Jenkins Bros. 40
Johns Hopkins University 77, 168

Kellogg, M. W., Co. 33
Keuffel & Esser Co. 54
Koppers Co. (Inc.) Fast's Coupling Dept. 110

Lefax 161
LimiTorque Corp. 90
Lincoln Electric Co. 82
Linear (Inc.) 157
*Link Belt Co. 147
*Lockheed Aircraft Corp. 174
Los Alamos Scientific Laboratory 181
Lovejoy Flexible Coupling Co. 89

McDonnell & Miller (Inc.) 70
M B Mfg. Co. 63, 129
MIT Lincoln Laboratory 60
Mammoth Furnace Co. 157
Marquardt Aircraft Co. 168
Marsh, James P., Corp. 22
*Martin Co. 57, 87
Melpar (Inc.) Sub. of Westinghouse Air Brake Co. 52
*Mercoid Corp. 83
Midwest Piping Co. 119
Miniature Precision Bearings (Inc.) 77
Motorola (Inc.) 178

Nagle Pumps (Inc.) 69
National Airoil Burner Co. 76
National Cash Register Co. 166
National Exposition of Power & Mechanical Engineering 96, 97
National Supply Co. 26
New Departure Div. General Motors Corp. 1
New Hampshire Ball Bearings (Inc.) 155
New York Air Brake Co. 121
Nice Ball Bearing Co. 163
North American Aviation (Inc.) 69, 142

Ohio Injector Co. 3rd Cover
Olin Mathieson Chemical Corp. 170

Pacific Semiconductors (Inc.) 183
*Pangborn Corp. 48
Pantex Mfg. Co. 191
*Peerless Pump Div. Food Machinery & Chemical Corp. 159
*Pennsylvania Pump & Compressor Co. 91
Philadelphia Gear Works 90
Pittsburgh Coke & Chemical Co. 172
Pittsburgh Lectrodryer Co. 100
Pittsburgh Piping & Equipment Co. 30
*Porter, H. K., Co. W-S Fittings Div. 47
*Posey Iron Works 158
Powell, William, Co. 111
Pratt & Whitney Div. United Aircraft Corp. 58, 71
Precision Rubber Products Corp. 149

Radio Corp. of America 172
Raybestos-Manhattan (Inc.) Manhattan Rubber Div. 120
Read Standard Corp. 46
Remington Rand Univac Div. Sperry Rand Corp. 173
*Republic Flow Meters Co. 114
Research-Cottrell (Inc.) 81
Revere Copper & Brass (Inc.) 18
Rhopac (Inc.) 159
Robertshaw-Fulton Controls Co. Bridgeport Thermostat Div. 53
Rocketdyne Div. North American Aviation (Inc.) 137
Rockford Clutch Div. Borg-Warner Corp. 84
Ronald Press Co. 76
*Roots-Connersville Blower Div. Dresser Industries (Inc.) 67
Rust-Oleum Corp. 125

Sanborn Co. 23
Sandia Corp. 161
Snap-Tite (Inc.) 101
*Southwest Products Co. 158
Spraying Systems Co. 91
Standard Oil Co. of Ohio 176
Stephens-Adamson Mfg. Co. 4, 5
*Syntron Co. 160

*Taylor Instrument Cos. 148
Temco Aircraft Corp. 177
*Tennessee Coal & Iron Div. 14, 15, 109, 122
*Terry Steam Turbine Co. 112
Texas Instruments (Inc.) 184
Thomas Flexible Coupling Co. 83
Timken Roller Bearing Co. 4th Cover

United States Graphite Co. Div. Wickes Corp. 12, 13, 164
United States Pipe & Foundry Co. 6, 7
*United States Steel Corp. 14, 15, 109, 122
*United States Steel Export Corp. 14, 15, 109, 122
University of California, Radiation Lab. 95

Van Der Horst Corp. of America 85
*Vogt, Henry, Machine Co. 103
*Voss, J. H. H., Co. 158

Waldes Kohinoor (Inc.) 113
Walworth Co. 116
*Westinghouse Electric Corp. 106, 152
Wiley, John & Sons 44
Winzeler Mfg. & Tool Co. 123
Wisconsin Motor Corp. 68
Wollensak Optical Co. 72

*Yarnall-Waring Co. 35
Yoder Co. 16

Advertisers appearing in previous 1956 issues

Ackerman Engravers
Acushnet Process Co.
*Adsco Industries (Inc.)
American District Steam Div.
*Aldrich Pump Co.
All American Tool & Mfg. Co.
*Allis-Chalmers Mfg. Co.
*Aluminum Co. of America
*American Pulverizer Co.
Annin Co.
Assembly Products (Inc.)
Atlas Chain & Mfg. Co.
Automatic Sprinkler Corp. of America

(Continued on page 191)

* The asterisk indicates that firm has product catalog in the 1957 Mechanical Catalog.

Your attention is directed to

Keep Informed 41–92
Consulting Service 188
Opportunities 165–186

*Badger Mfg. Co.
Barco Mfg. Co.
*Bearfum Metals Corp.
Bigelow-Liptak Corp.
Brown Boveri Corp.
Buck Mfg. Co.
Byers, A. M., Co.

Carrier Conveyor Corp.
*Cash, A. W., Co.
*Cash, A. W., Valve Mfg. Co.
Chace, W. M., Co.
Chapman Valve Mfg. Co.
Char-Lynn Co.
Chicago Rawhide Mfg. Co.
Clarage Fan Co.
Clearprint Paper Co.
*Cleaver-Brooks Co.
*Cochrane Corp.
Coxhead, Ralph C., Corp.
Cratex Co.

*Diamond Power Specialty Corp.
Drop Forging Assoc.
Duff-Norton Co.

Electrofilm (Inc.)
Ellison Draft Gage Co.

Fairbanks, Morse & Co.
*Falk Corp.
Farrel-Birmingham Co.
Ford Instrument Co.
Div. Sperry Rand Corp.
*Foxboro Co.

*Gear Specialties (Inc.)
*Goulds Pumps (Inc.)
*Grinnell Co.

Hagan Corp.
Hamilton Mfg. Co.
Hankison Corp.
Hathaway Instrument Co.
Sub. Hamilton Watch Co.
*Hyatt Bearings Div.
General Motors Corp.

*Illinois Gear & Machine Co.
Imperial Tracing Cloth
Irving Subway Grating Co.

*Johns-Manville
Johnson, Carlyle, Machine Co.

Kennametal (Inc.)
*Kewanee Boiler Div.
American-Standard
Kollmorgen Optical Corp.
Koppers Co.
Precipitator Dept.
Kunkle Valve Co.

*Ladish Co.
Lake Shore (Inc.)
Lake Shore Engrg. Div.
Lenape Hydraulic Pressing & Forging Co.
Link Aviation (Inc.)
*Loewy Hydropress Div.
Baldwin-Lima-Hamilton
Lunkenheimer Co.

McGraw-Hill Book Co.
Manzel Div.
Houdaille Industries (Inc.)
Maryland Shipbuilding & Drydock Co.
Meriam Instrument Co.

National Acme Co.
National Heater Co.
National Pneumatic Co.
Niagara Blower Co.
Norden-Ketay Corp.
*Northern Blower Co.
Nugent, Wm. W. & Co.

*Oilgear Co.

Pacific Pumps
Div. Dresser Industries (Inc.)
Parker White-Metal Co.
Peerless Electric Co.
Perfection Gear Co.
American Stock Gear Div.
*Powers Regulator Co.

Racine Hydraulics & Machinery Co.
Raybestos-Manhattan (Inc.)
Packing Div.
Reliance Electric & Engineering Co.
Reliance Gauge Column Co.
Republic Mfg. Co.
Resnor Mfg. Co.
Ric-Wil (Inc.)
Rockwell Mfg. Co.
Nordstrom Valve Div.
Ross Heat Exchanger Div.
American-Standard
Ruthman Machinery Co.

Sierra Engineering Co.
Springfield Boiler Co.
*Stewart, F. W., Corp.
Stewart-Warner Corp.
Alemite Div.
Stock Equipment Co.
Streeter-Amet Co.
*Struthers Wells Corp.
Div. Titusville Iron Works Co.
Sturtevant, P. A., Co.
Synchro-Start Products (Inc.)

*Taylor Forge & Pipe Works
*Tube Turns

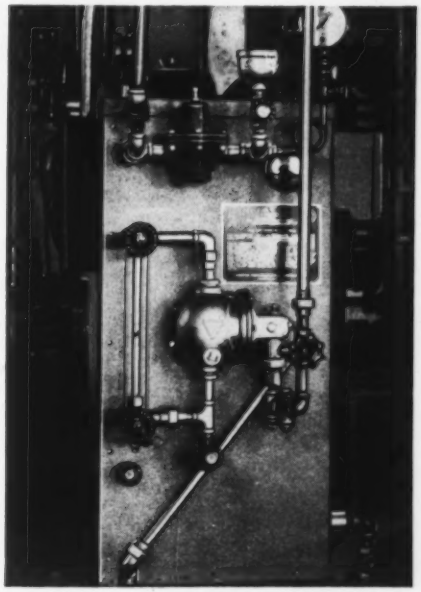
*Union Iron Works
Union Spring & Mfg. Co.
*U.S. Hoffman Machine Corp.

Vard (Inc.)
Vickers (Inc.)
Div. Sperry Rand Corp.

Watson-Stillman Press Div.
Farrel-Birmingham Co.
Wheeler, C. H., Mfg. Co.
*Wickes Boiler Co.
Div. of Wickes Corp.
Wiegand, Edwin L., Co.
Williams Gauge Co.
*Wolverine Tube Div.
Calumet & Hecla (Inc.)

Zallea Brothers

Pantex Speedylectric Steam Generator



UL Listed
ASME Code

Ideal Steam Source for Pilot, Lab and Test Work

permits precise control of pressure and quality . . . eliminates operator, odor, fumes, fire hazard

Industry uses this "extra" steam boiler in many ways to facilitate production, reduce costs and eliminate fire and explosion hazards. For pilot operations, laboratories and tests the Speedylectric Steam Generator often proves the only answer to steam needs.

It can be installed right in a laboratory, for it requires little space and practically no attention or maintenance. It is silent, odorless, free from fumes and hazards of fire or explosion. It exactly and automatically maintains any desired pressure, and constant quality 98 per cent dry steam. Utilizing the Speedylectric electrode principle, it generates steam electrically, at surprisingly low cost. Capacities from 2 to 60 Bhp; 15 to 500 Psi; for 220, 440, 550 volts AC. USE COUPON to get complete details.

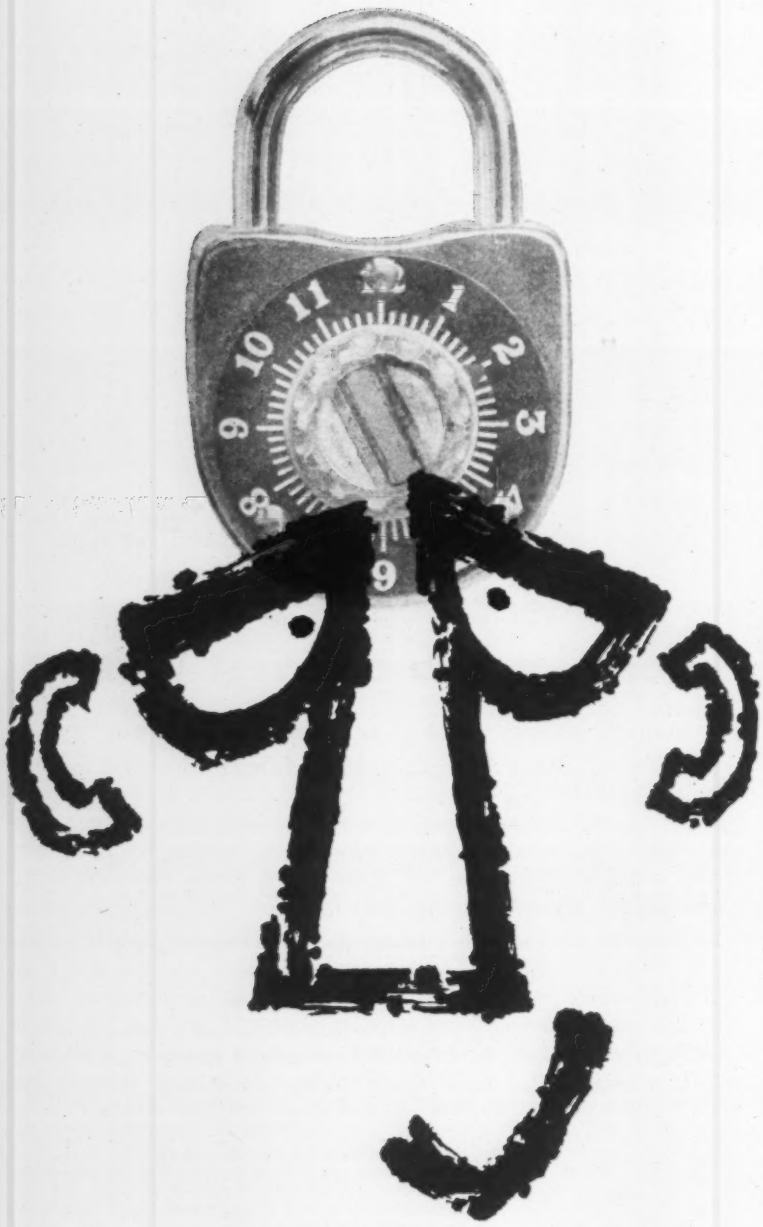
Speedylectric Steam-Jet Cleaner lets one man do the work of five. High pressure jet of dry steam and solvents quickly removes grease and dirt accumulations from machines and equipment without flooding floors. No need to stop nearby production or move machines outside. Completely safe and portable.

PANTEX MANUFACTURING CORPORATION
Box 660AJ, Pawtucket10, R. I.

Send me facts and figures on:

☐ Pantex Speedylectric Steam Generator
☐ Pantex Speedylectric Steam-Jet Cleaners

Name and Title .....
Company .....
Address .....



keeping an idea locked between your ears?

If that idea deals with the Guided Missile field, you'll find that Firestone has the key to unlock it—and open the door to a happier future for you. Firestone's creative climate and tangible rewards keep that door open to a steady flow of achievement.

Since the turn of the century, Firestone has built its phenomenal progress on men with ideas. Currently, Firestone is carrying forward the Army's vital program for the "Corporal," first surface-to-surface ballistic guided missile. This involves engineering, field test and service, and missile and component development.

But we need more men to fill more key spots than we can list here:

Electronic Systems
Propulsion Components
Flight Simulation
Mechanical Structures and Dynamics
Field Engineering

Let's get together to make the most of that idea...and your future. Write us today!

Firestone

GUIDED MISSILE DIVISION

RESEARCH • DEVELOPMENT • MANUFACTURE

"Find your Future at Firestone"—Los Angeles • Monterey

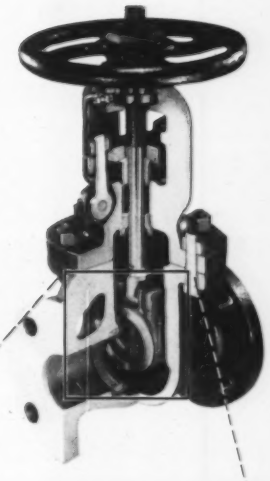
WRITE: SCIENTIFIC STAFF DIRECTOR, LOS ANGELES 54, CALIF.

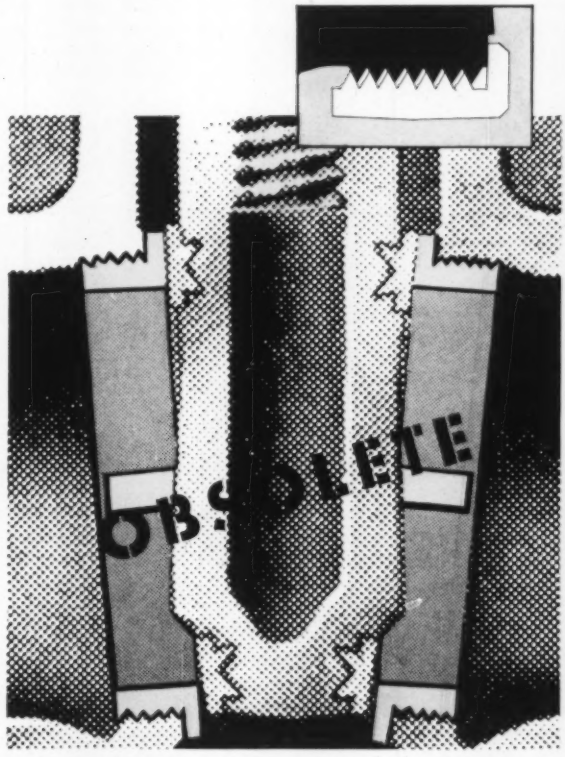
ARE YOUR TRIM SPECS UP TO DATE?

Put an end to iron valve seat ring and stem-wedge problems. Make sure your specifications call for modern, trouble-free OIC end-seated seat rings and T-head stems.

There is no extra cost and yet this superior design will reduce your maintenance overhead many times.

For specification details write for OIC Iron Valve Bulletin No. 1005. The Ohio Injector Co., Wadsworth, Ohio.

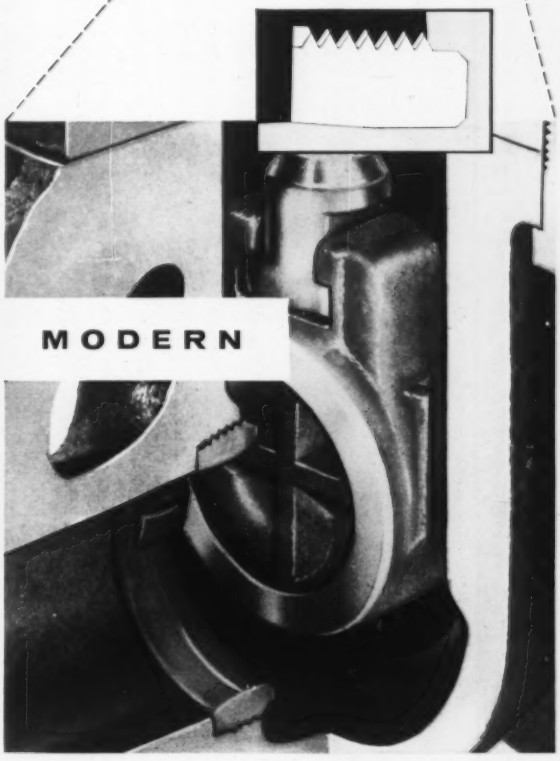




Shoulder-seated rings
Screwed stem-wedge connection

Ring design causes turbulence. Open back of ring is easily eroded. Ring is seated in tension. Continuous operation compresses and tends to loosen it, developing serious leaks.

A screwed stem-wedge connection is rigid. Closing valve under pressure tends to bind wedge, make closing difficult and perhaps bend the stem.



OIC end-seated rings
T-head, stem-wedge connection

Streamlined flow-through. No pockets open to attack by erosion. Ring is seated in compression. Stays tight even in continuous operation.

T-head stem-wedge connection is flexible. Wedge can't bind. Closing is easy and stem is unaffected.

OIC VALVES | FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON VALVES

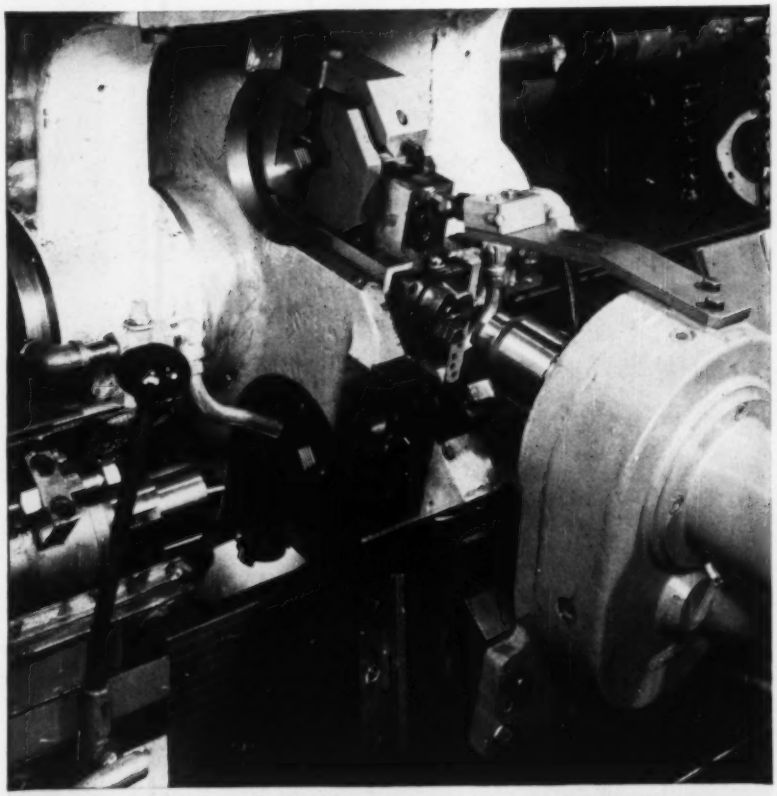
More precision — no more backlash after turret was mounted on TIMKEN® bearings

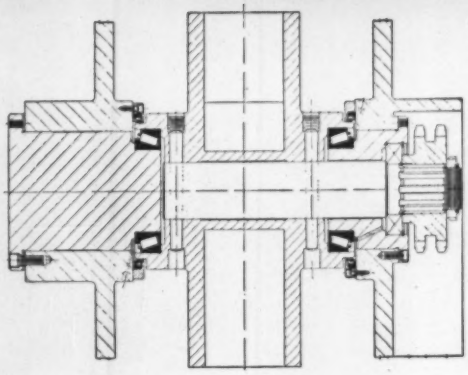
50 Timken® bearings are used in this Model 365 New Britain chucking machine, which can machine both ends of suitable castings or forgings simultaneously. The turret spindle of this machine was originally mounted on a plain bushing. This method did not eliminate backlash completely. When Timken tapered roller bearings were mounted at each end of the turret shaft, backlash was eliminated altogether, rejects cut. Timken bearings also prevent chatter and insure precision because they can be preloaded to any degree necessary to maintain the required rigidity.

Timken bearings can handle heavy loads because they carry them on the lines of contact between rollers and races. Their tapered construction permits them to take radial and thrust loads in any combination. Geometrically designed for true rolling motion and precision manufactured to live up to their design, Timken bearings practically eliminate friction.

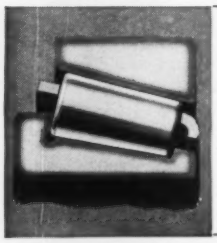
We even make our own special analysis steel to be sure Timken bearings are the best. We're the only U. S. bearing maker that does. When you buy or build machines, always specify Timken bearings. Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.





How **THE NEW BRITAIN MACHINE COMPANY** mounts the turret of its Model 365 Double-End Automatic Chucking Machine on Timken bearings to improve precision, minimize maintenance.



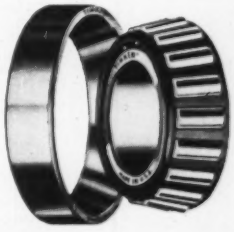
GREATER LOAD AREA

Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer. The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis Timken steels.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ⊂ THE TIMKEN TAPERED ROLLER ⊂ BEARING TAKES RADIAL ◎ AND THRUST →◎← LOADS OR ANY COMBINATION →◎←